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(54) **SYSTEM AND METHOD FOR PROVIDING MULTI-MODE WIRELESS DATA DISTRIBUTION**

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See application file for complete search history.

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(57) **ABSTRACT**

A distribution system for vehicle information systems and methods for manufacturing and using the same. The distribution system supports both Wi-Fi- and cellular-based wireless networks for the distribution of selected content to a plurality of handheld devices disposed throughout a passenger vehicle via a bypass system (e.g., a Local Internet Protocol Access (LIPA) and Selected Internet Protocol Traffic Offload (SIPTO) bypass system). In an alternative embodiment, the distribution system can be configured for distribution of the selected content from a terrestrial content system to a plurality of passenger vehicles via the bypass system. By dynamically balancing network traffic across the multiple wireless networks, the distribution system can alleviate heavy traffic network and bypass a service provider's cellular core network to optimize signal bandwidth and network performance. As a result, passengers traveling aboard the vehicle can enjoy high-speed access to content with limited delay and without incurring additional charges.

22 Claims, 16 Drawing Sheets

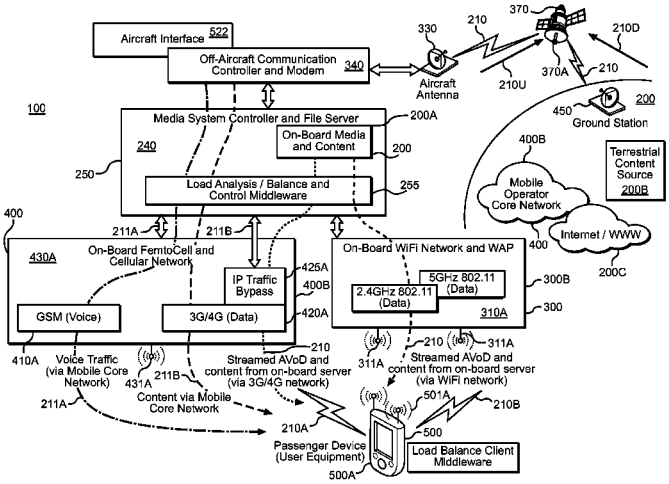

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FIG. 1A

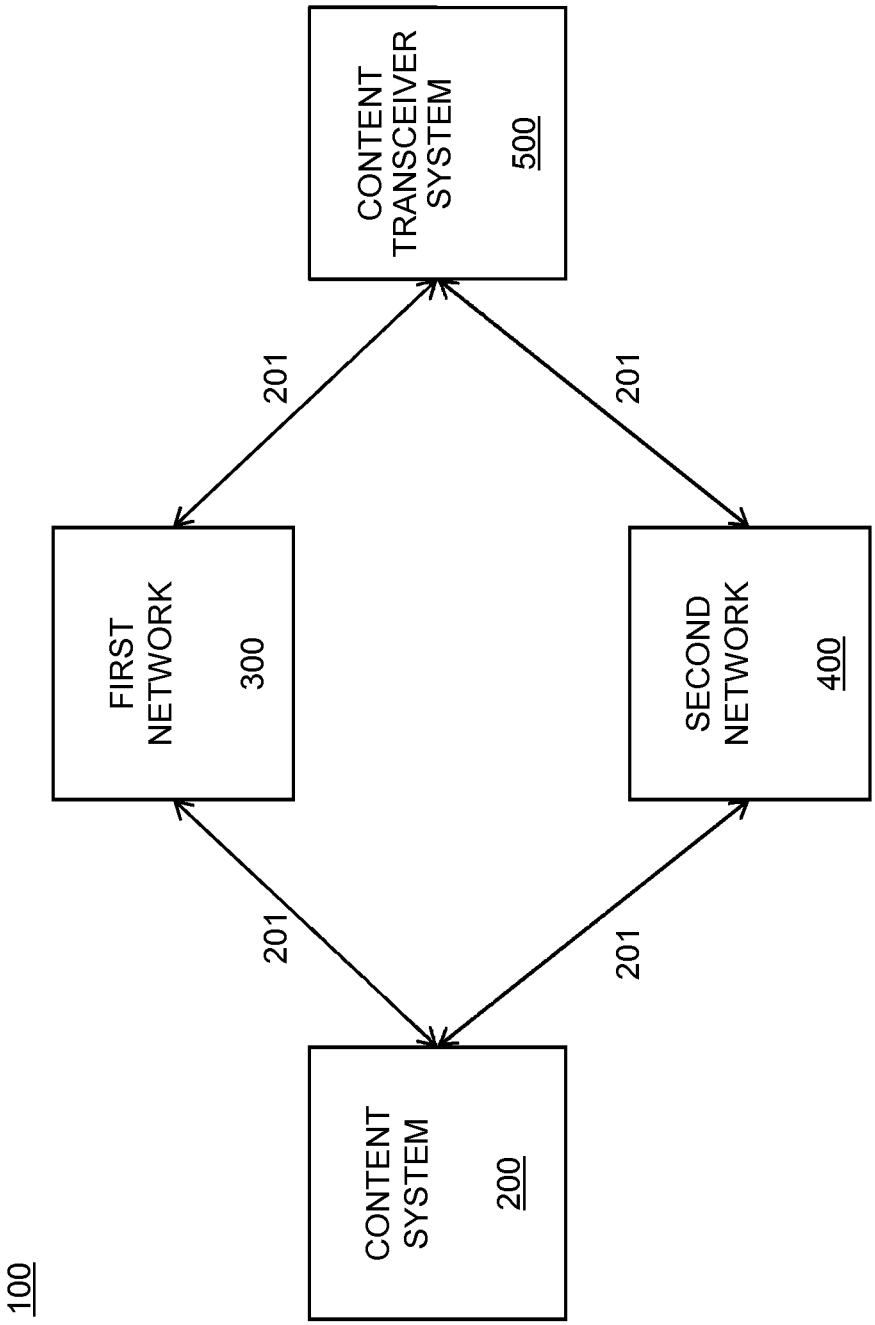
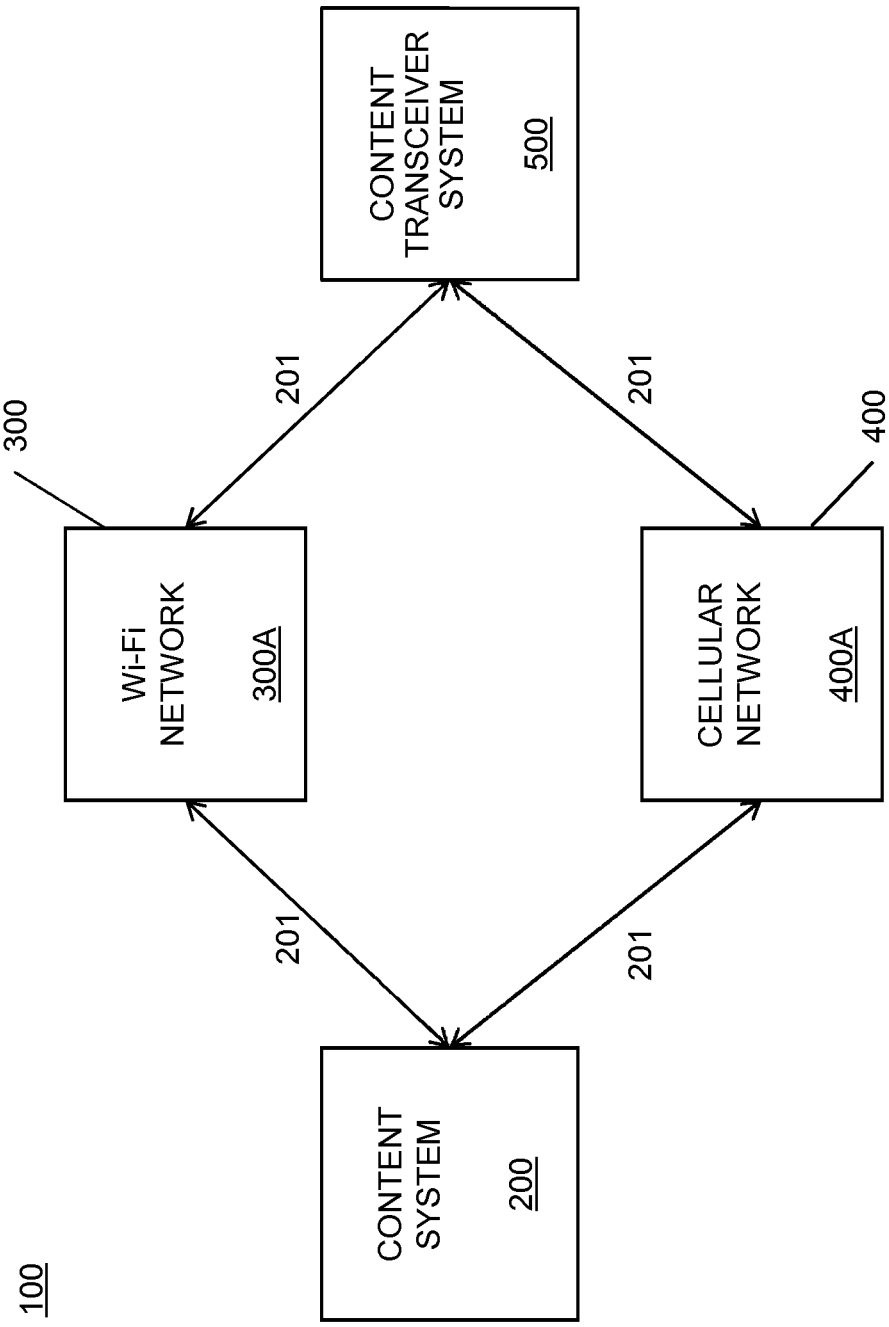

CONTENT TRANSCEIVER SYSTEM 500
201
201
FIRST NETWORK 300
SECOND NETWORK 400
201
201
CONTENT SYSTEM 200
100

FIG. 1B


CONTENT TRANSCEIVER SYSTEM 500
201
201
300
400
Wi-Fi NETWORK 300A
CELLULAR NETWORK 400A
201
201
CONTENT SYSTEM 200
100

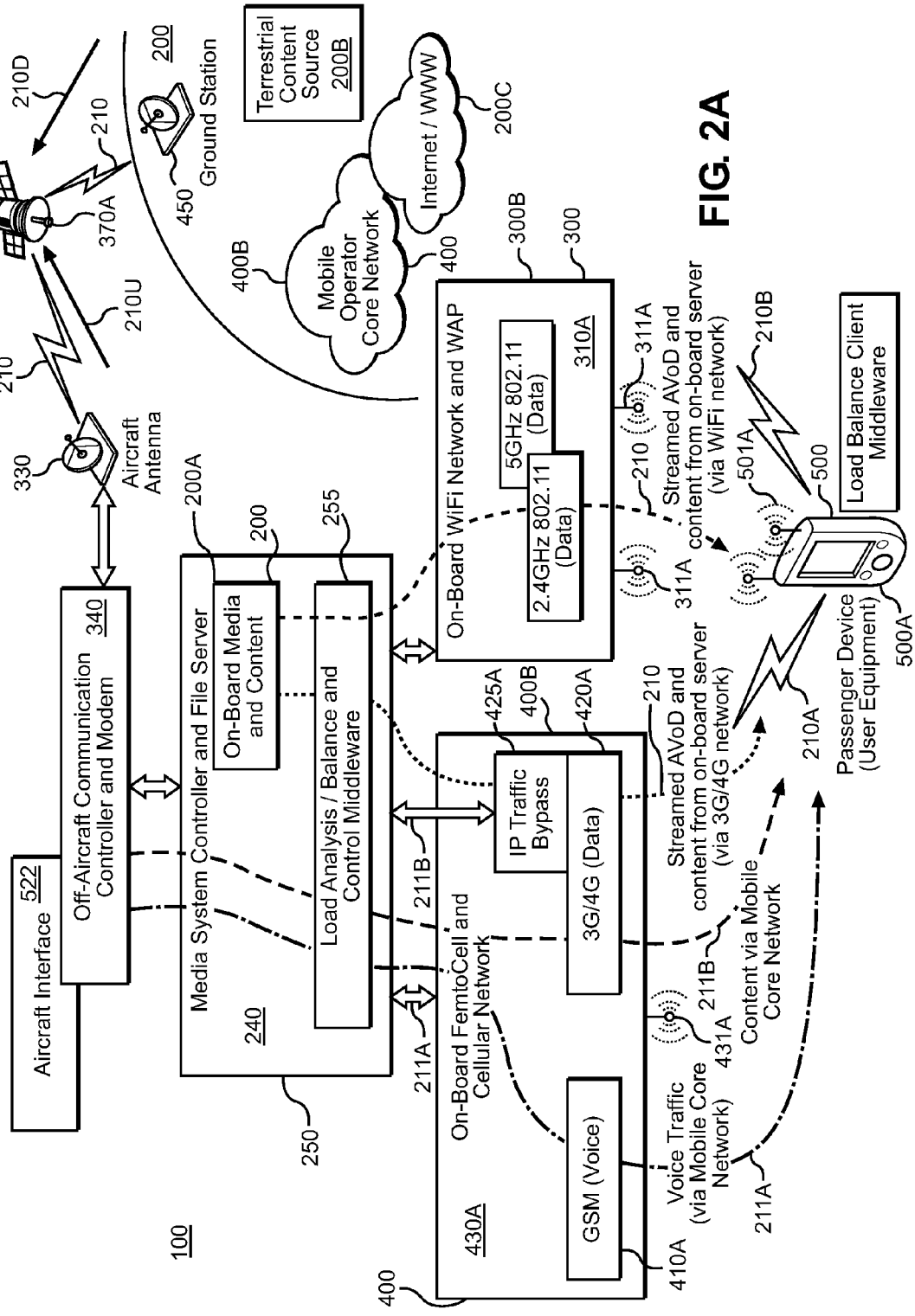

100
Aircraft Interface 522
Off-Aircraft Communication Controller and Modem 340
Media System Controller and File Server 240
On-Board Media and Content 200
Load Analysis / Balance and Control Middleware 255
200A
200
250
On-Board FemtoCell and Cellular Network 430A
GSM (Voice) 410A
3G/4G (Data) 420A
IP Traffic Bypass 425A
400B
400
211A
211B
Voice Traffic (via Mobile Core Network) 431A
Content via Mobile Core Network
Streamed AVoD and content from on-board server (via 3G/4G network)
On-Board WiFi Network and WAP 300
2.4GHz 802.11 (Data)
5GHz 802.11 (Data) 310A
300B
311A
Streamed AVoD and content from on-board server (via WiFi network)
210B
501A
500
Load Balance Client Middleware
Passenger Device (User Equipment) 500A
210A
Aircraft Antenna 330
370
370A
210
210D
210U
Ground Station 450
200
Terrestrial Content Source 200B
Mobile Operator Core Network 400B
Internet / WWW 200C

FIG. 2A

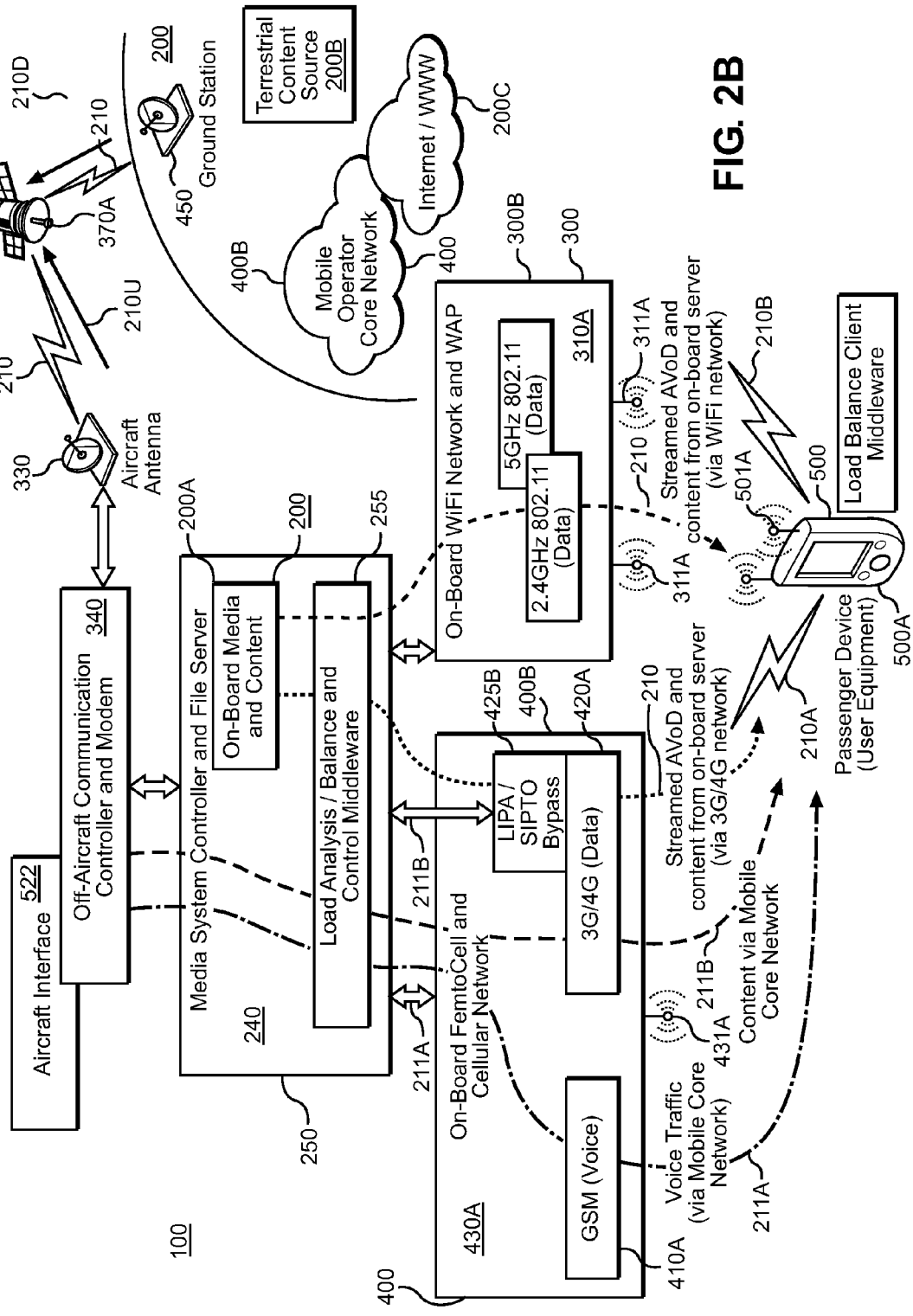

100
Aircraft Interface 522
Off-Aircraft Communication Controller and Modem 340
Media System Controller and File Server 240
On-Board Media and Content 200A
Load Analysis / Balance and Control Middleware 200 255
250
On-Board FemtoCell and Cellular Network 400
430A
GSM (Voice) 410A
3G/4G (Data)
LIPA / SIPTO Bypass 425B
420A
211A
211B
Voice Traffic (via Mobile Core Network) 431A
Content via Mobile Core Network
Streamed AVoD and content from on-board server (via 3G/4G network) 210
On-Board WiFi Network and WAP 300
2.4GHz 802.11 (Data)
5GHz 802.11 (Data) 310A
311A
Streamed AVoD and content from on-board server (via WiFi network)
Load Balance Client Middleware 500
Passenger Device (User Equipment) 500A
501A
210A
210B
Aircraft Antenna 330
370
370A
210
210U
210D
Ground Station 450
200
Terrestrial Content Source 200B
Internet / WWW 200C
Mobile Operator Core Network 400
400B
300B

FIG. 2B

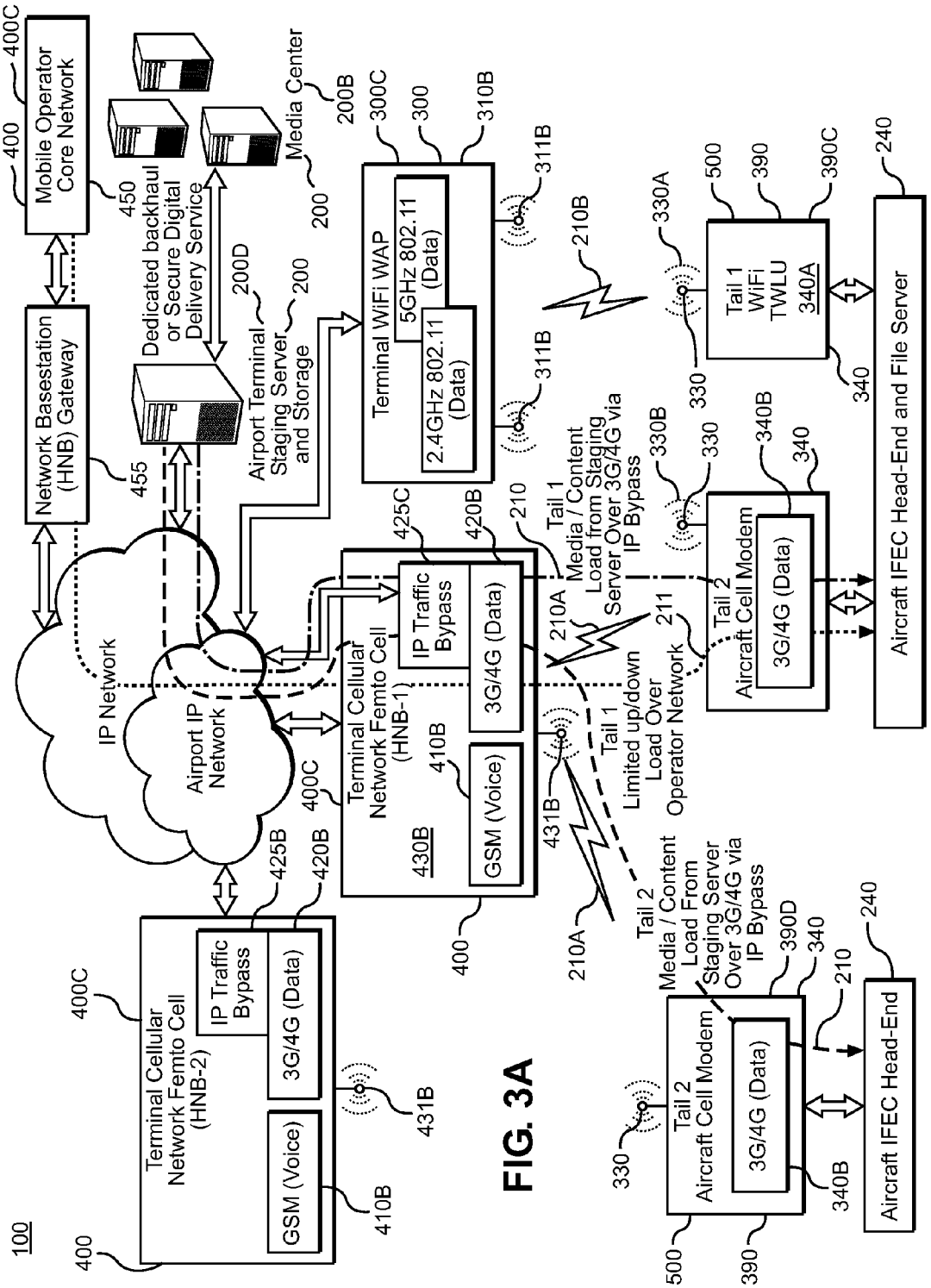

100
400
Terminal Cellular Network Femto Cell (HNB-2)
400C
IP Traffic Bypass
3G/4G (Data)
GSM (Voice)
425B
420B
410B
431B
IP Network
Airport IP Network
Network Basestation (HNB) Gateway
455
Mobile Operator Core Network
400
400C
450
Dedicated backhaul or Secure Digital Delivery Service
200D
Airport Terminal Staging Server and Storage
200
Media Center
200
200B
Terminal WiFi WAP
300C
300
5GHz 802.11 (Data)
2.4GHz 802.11 (Data)
310B
311B
311B
Terminal Cellular Network Femto Cell (HNB-1)
430B
425C
420B
410B
IP Traffic Bypass
3G/4G (Data)
GSM (Voice)
210
210A
210B
Tail 1 Media / Content Load from Staging Server Over 3G/4G via IP Bypass
Tail 1 Limited up/down Load Over Operator Network
211
330A
330B
330
330
Tail 1 WiFi TWLU
340A
500
390
390C
340
340B
340
Tail 2 Aircraft Cell Modem
3G/4G (Data)
Aircraft IFEC Head-End and File Server
240
Tail 2 Media / Content Load From Staging Server Over 3G/4G via IP Bypass
390D
340
210
Tail 2 Aircraft Cell Modem
3G/4G (Data)
Aircraft IFEC Head-End
240
500
390
340B

FIG. 3A

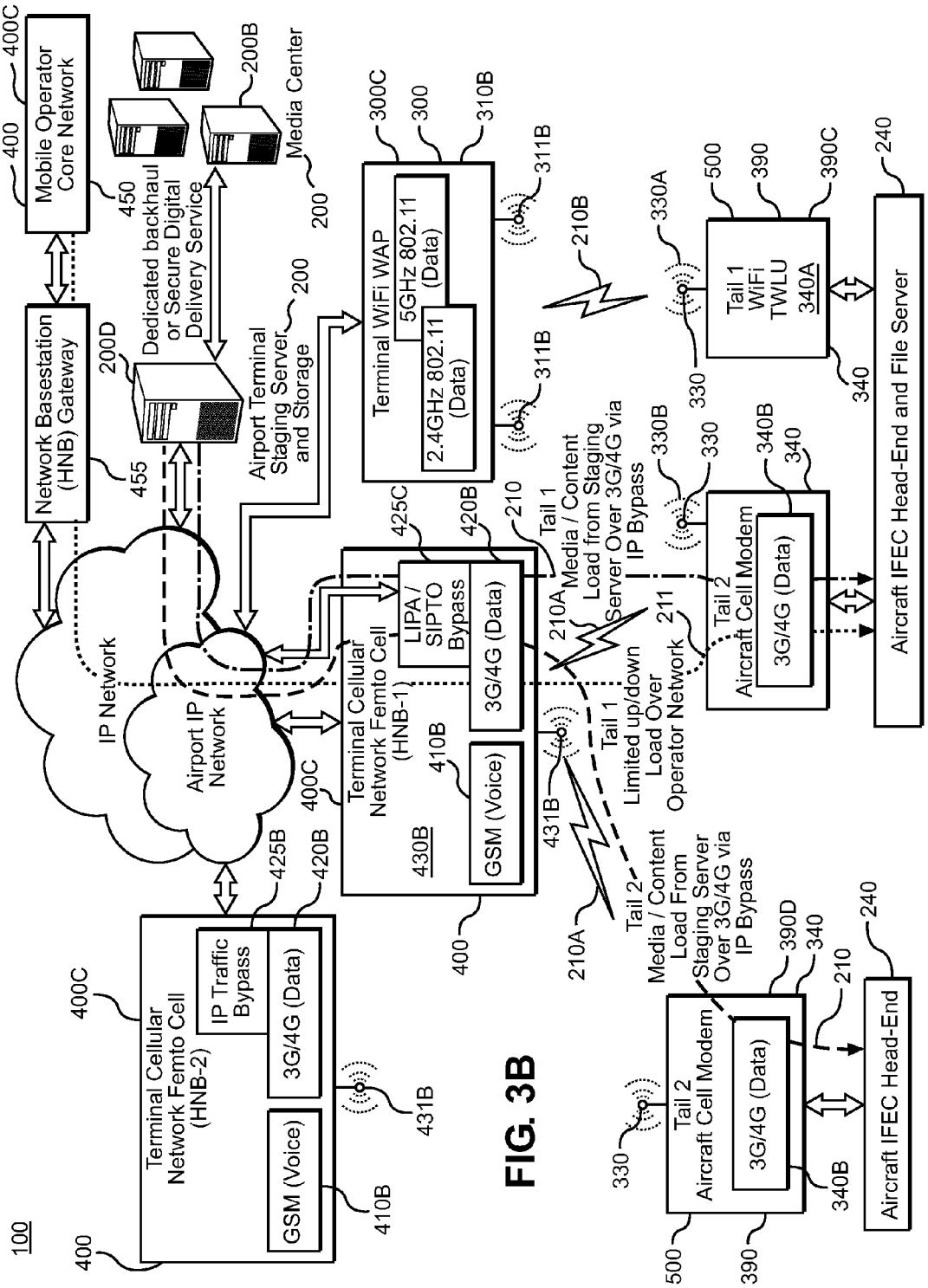

100
400
Terminal Cellular Network Femto Cell (HNB-2)
400C
IP Traffic Bypass
3G/4G (Data)
GSM (Voice)
425B
420B
410B
431B
IP Network
Airport IP Network
Network Basestation (HNB) Gateway
455
Mobile Operator Core Network
400
400C
450
Dedicated backhaul or Secure Digital Delivery Service
200D
Airport Terminal Staging Server and Storage
200
Media Center
200B
Terminal Cellular Network Femto Cell (HNB-1)
430B
LIPA / SIPTO Bypass
3G/4G (Data)
GSM (Voice)
425C
420B
410B
400C
400
Terminal WiFi WAP
300C
300
5GHz 802.11 (Data)
2.4GHz 802.11 (Data)
310B
311B
311B
210
Tail 1
Media / Content Load from Staging Server Over 3G/4G via IP Bypass
210A
Tail 1 Limited up/down Load Over Operator Network
211
210B
330A
330B
330
330
Tail 1 WiFi TWLU
340A
500
390
390C
340
Tail 2 Aircraft Cell Modem
3G/4G (Data)
340B
340
Aircraft IFEC Head-End and File Server
240
Tail 2 Media / Content Load From Staging Server Over 3G/4G via IP Bypass
210A
330
Tail 2 Aircraft Cell Modem
3G/4G (Data)
500
390
390D
340
340B
210
Aircraft IFEC Head-End
240

FIG. 3B

FIG. 4A

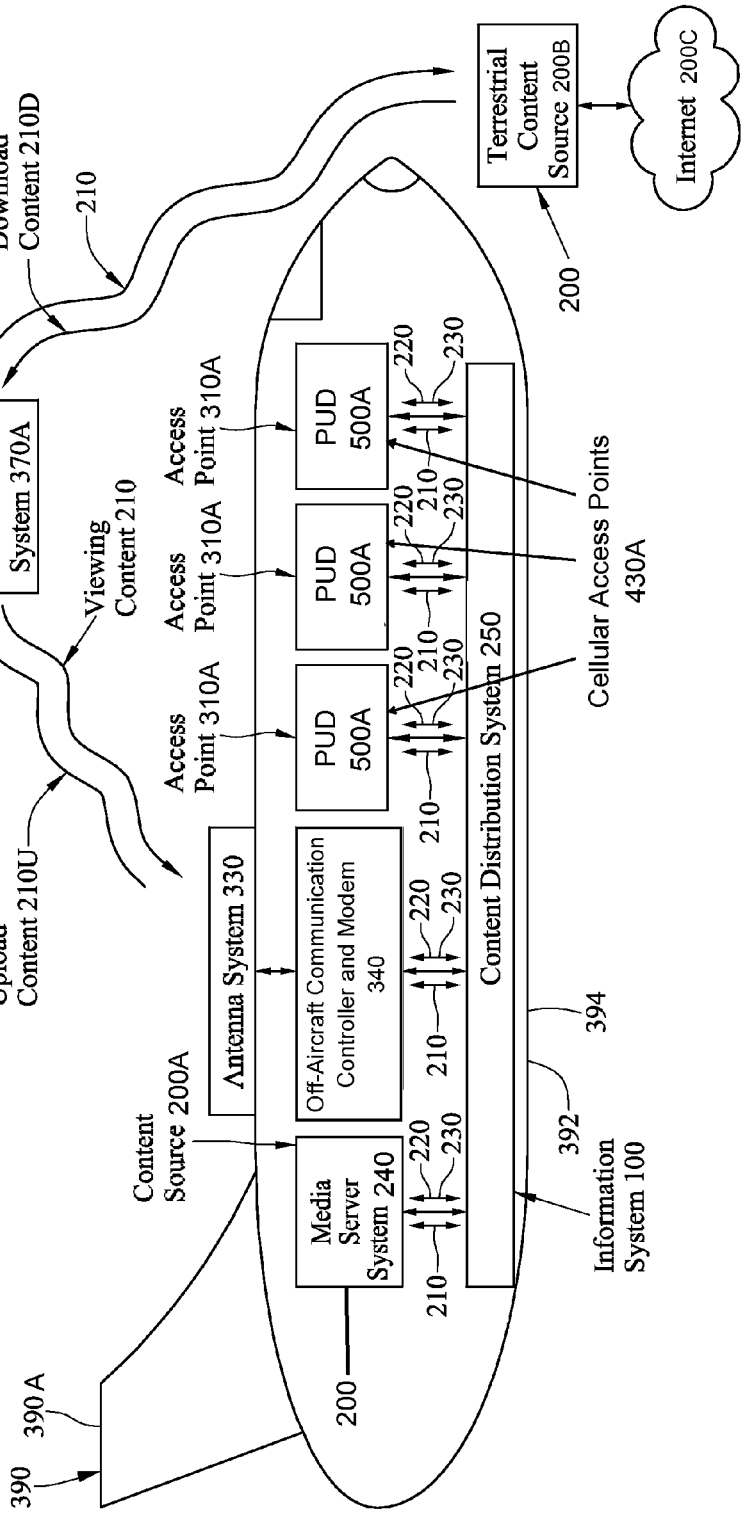

Communication System 370
Satellite Communication System 370A
Download Content 210D
210
Terrestrial Content Source 200B
Internet 200C
200
Viewing Content 210
Upload Content 210U
Access Point 310A
PUD 500A
220
230
210
Cellular Access Points 430A
Antenna System 330
Off-Aircraft Communication Controller and Modem 340
Content Source 200A
Media Server System 240
Content Distribution System 250
392
394
Information System 100
390
390A

FIG. 4B

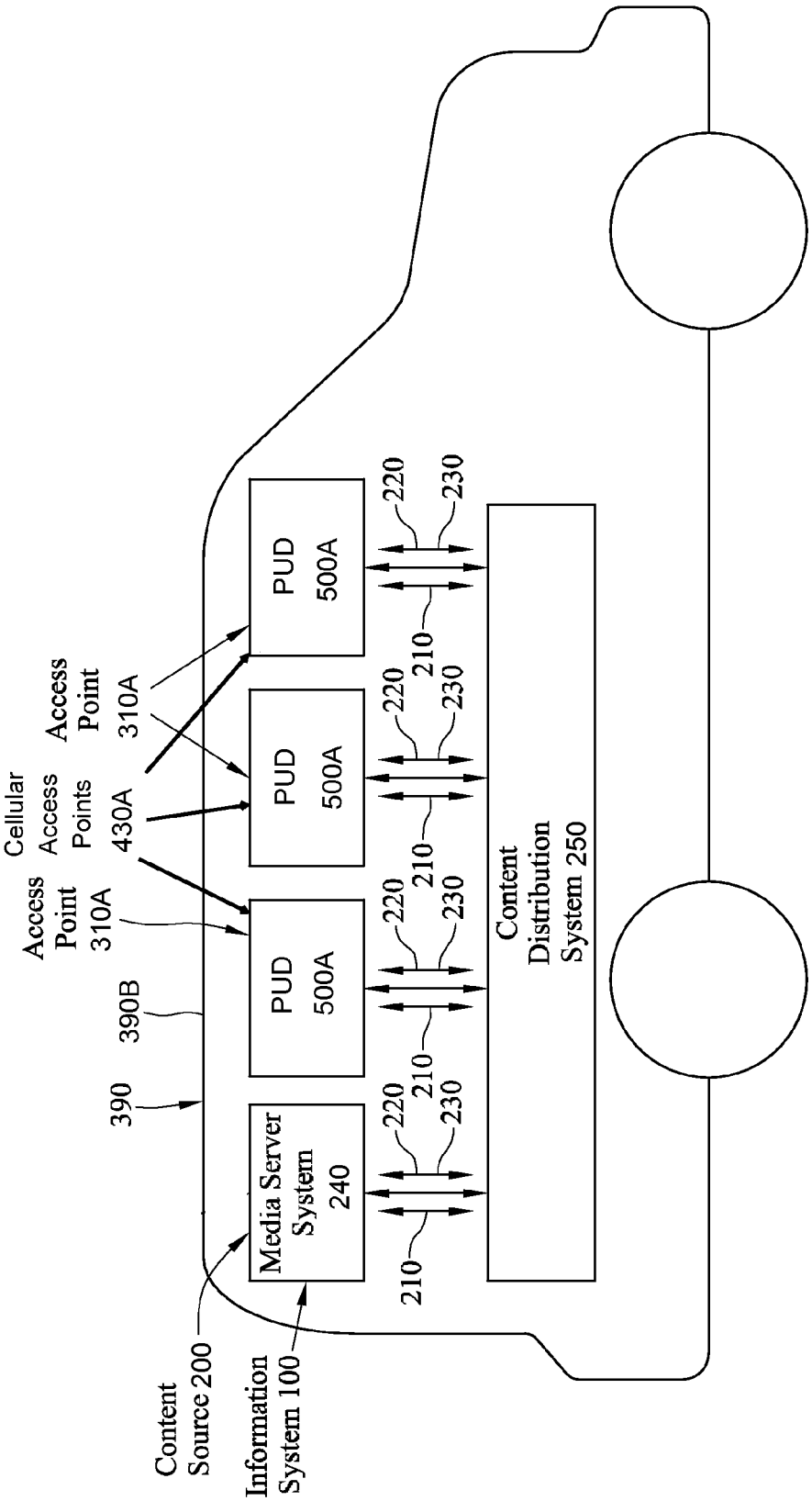

Content Source 200
Information System 100
Media Server System 240
PUD 500A
PUD 500A
PUD 500A
Content Distribution System 250
390
390B
Access Point 310A
Cellular Access Points 430A
Access Point 310A
210
220
230

FIG. 5

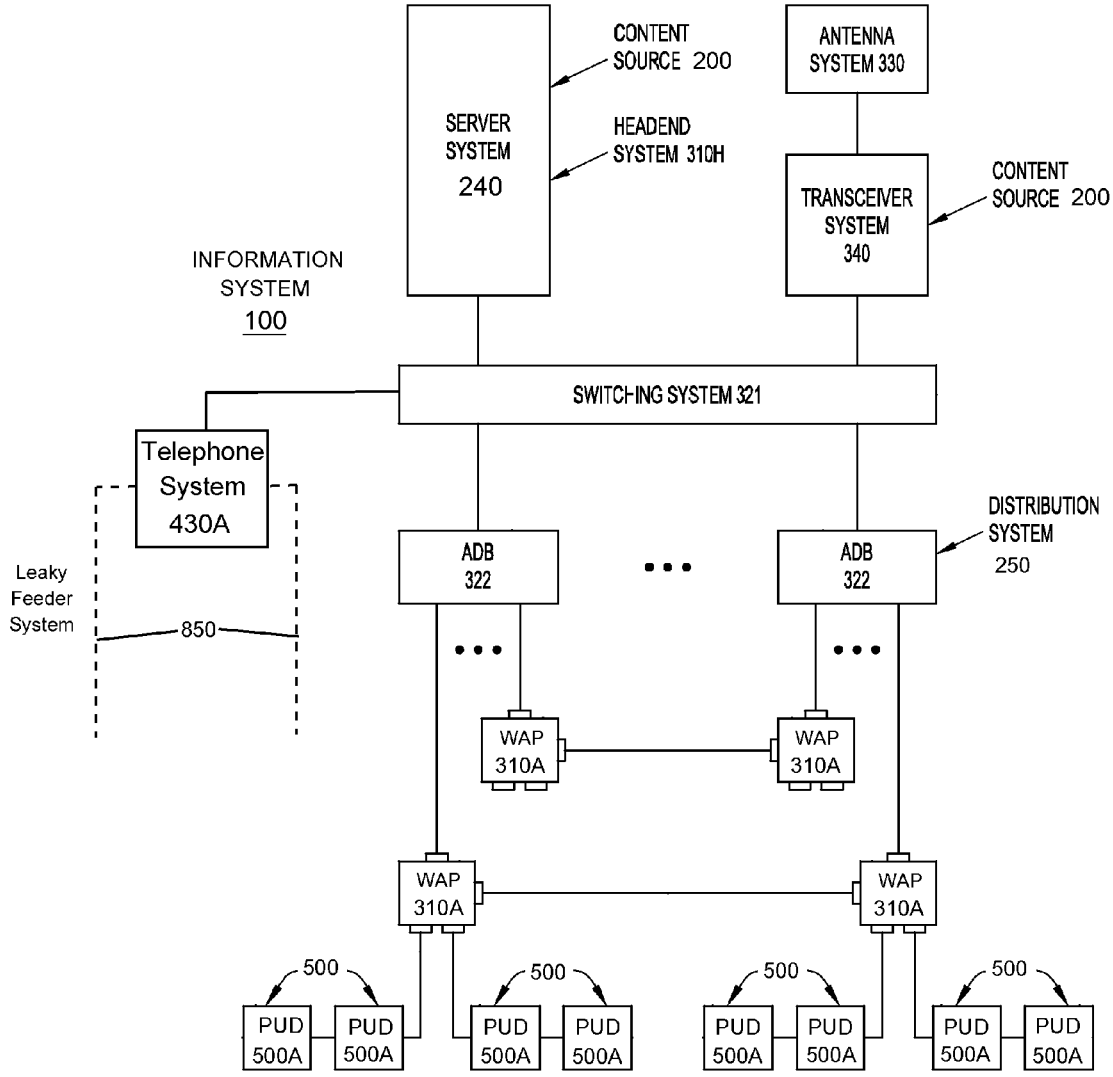

SERVER SYSTEM 240
CONTENT SOURCE 200
HEADEND SYSTEM 310H
ANTENNA SYSTEM 330
TRANSCEIVER SYSTEM 340
CONTENT SOURCE 200
INFORMATION SYSTEM 100
SWITCHING SYSTEM 321
Telephone System 430A
Leaky Feeder System
850
ADB 322
ADB 322
DISTRIBUTION SYSTEM 250
WAP 310A
WAP 310A
WAP 310A
WAP 310A
500
500
500
500
PUD 500A
PUD 500A
PUD 500A
PUD 500A
PUD 500A
PUD 500A
PUD 500A
PUD 500A

FIG. 6

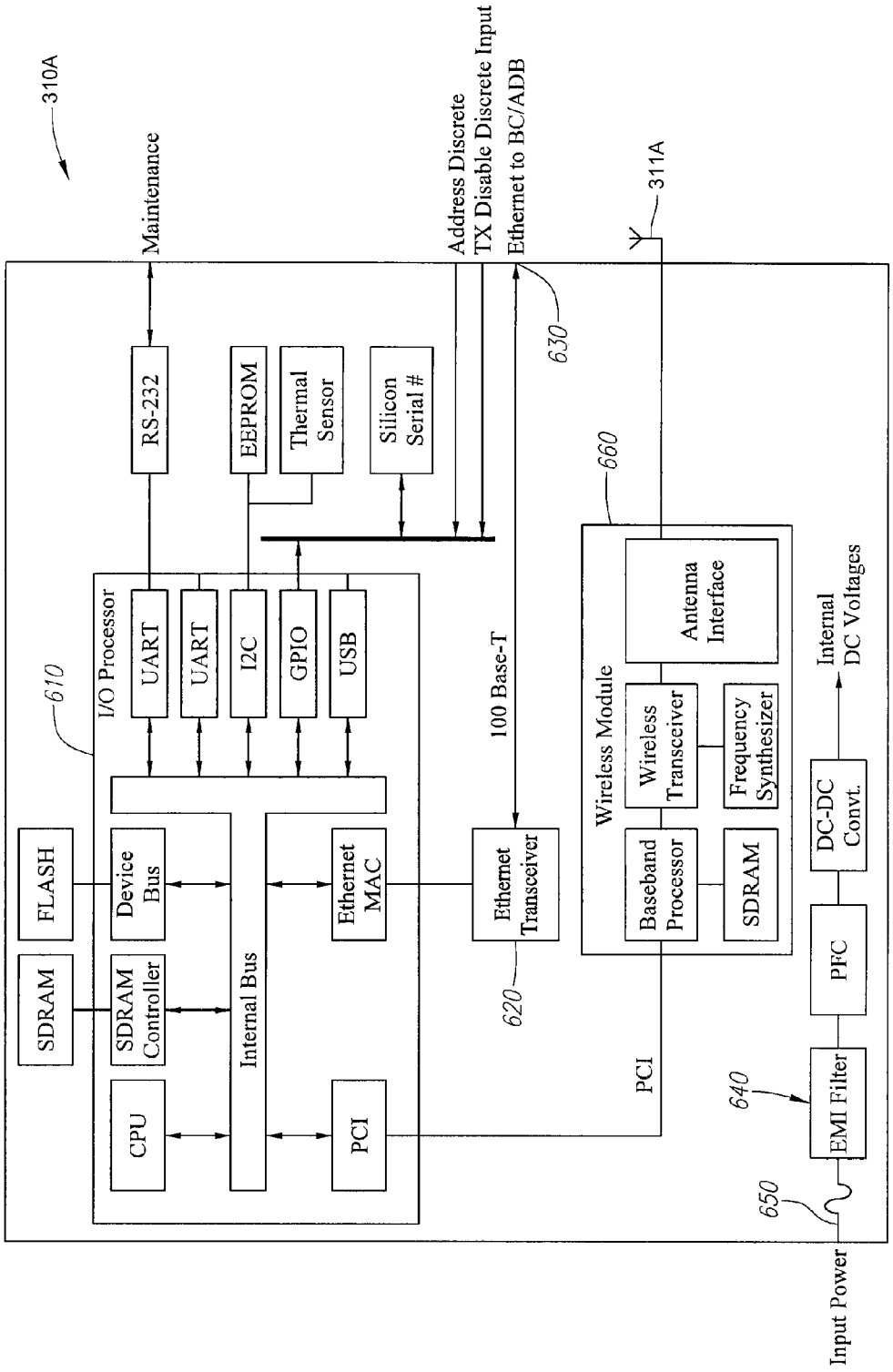
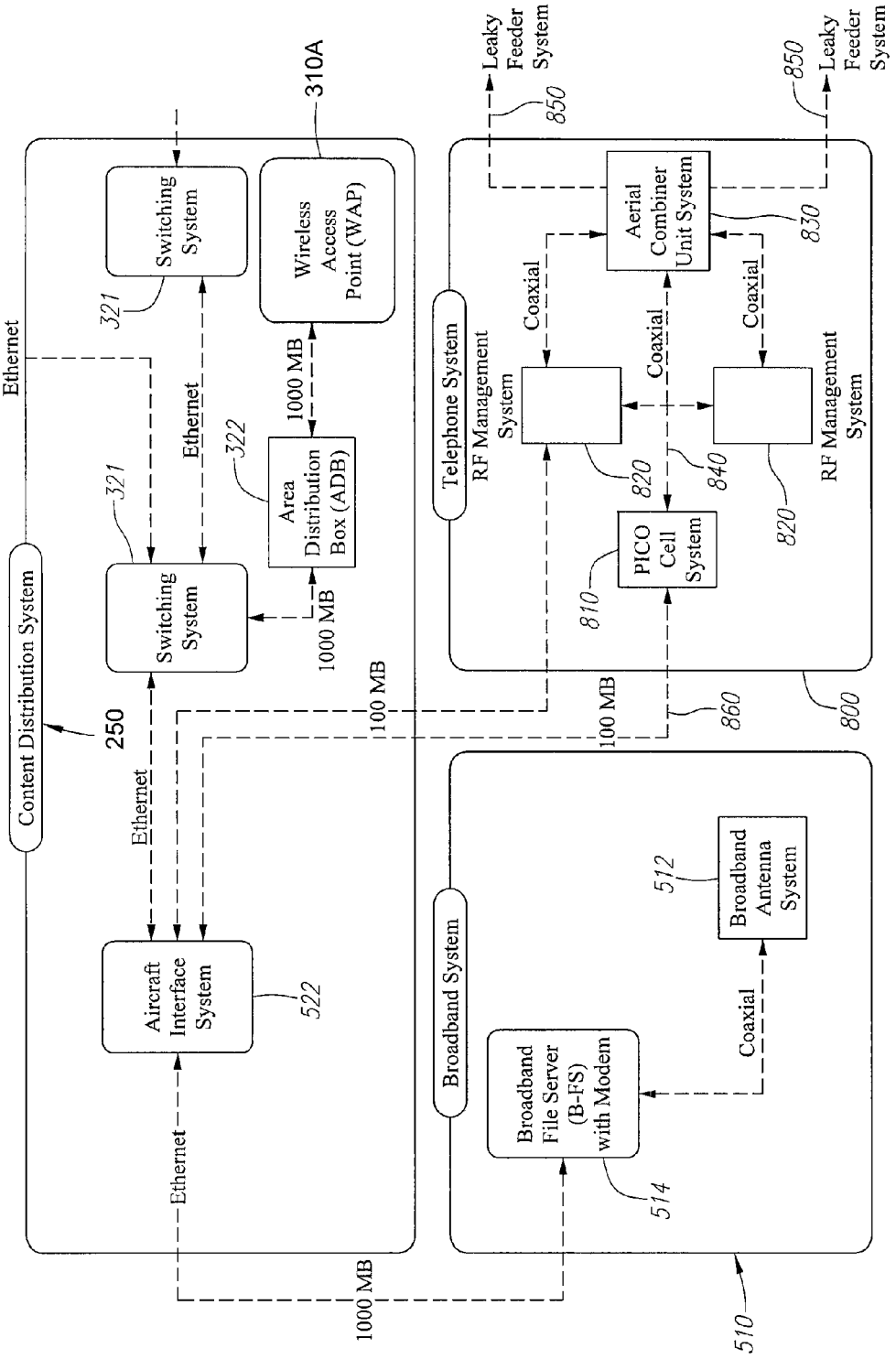

310A
Maintenance
Address Discrete
TX Disable Discrete Input
Ethernet to BC/ADB
311A
630
660
610
I/O Processor
RS-232
EEPROM
Thermal Sensor
Silicon Serial #
UART
UART
I2C
GPIO
USB
100 Base-T
Antenna Interface
Wireless Module
Wireless Transceiver
Frequency Synthesizer
Baseband Processor
SDRAM
FLASH
Device Bus
Ethernet MAC
Ethernet Transceiver
620
SDRAM Controller
Internal Bus
CPU
PCI
PCI
DC-DC Convt.
Internal DC Voltages
PFC
640
EMI Filter
650
Input Power

FIG. 7


100
Content Distribution System
250
Ethernet
Switching System
321
Switching System
321
Ethernet
Ethernet
Aircraft Interface System
522
Ethernet
1000 MB
310A
Wireless Access Point (WAP)
1000 MB
322
Area Distribution Box (ADB)
1000 MB
100 MB
Leaky Feeder System
850
Leaky Feeder System
850
Telephone System
RF Management System
Coaxial
Aerial Combiner Unit System
830
Coaxial
Coaxial
820
840
820
RF Management System
PICO Cell System
810
100 MB
860
800
Broadband System
512
Broadband Antenna System
Coaxial
Broadband File Server (B-FS) with Modem
514
510

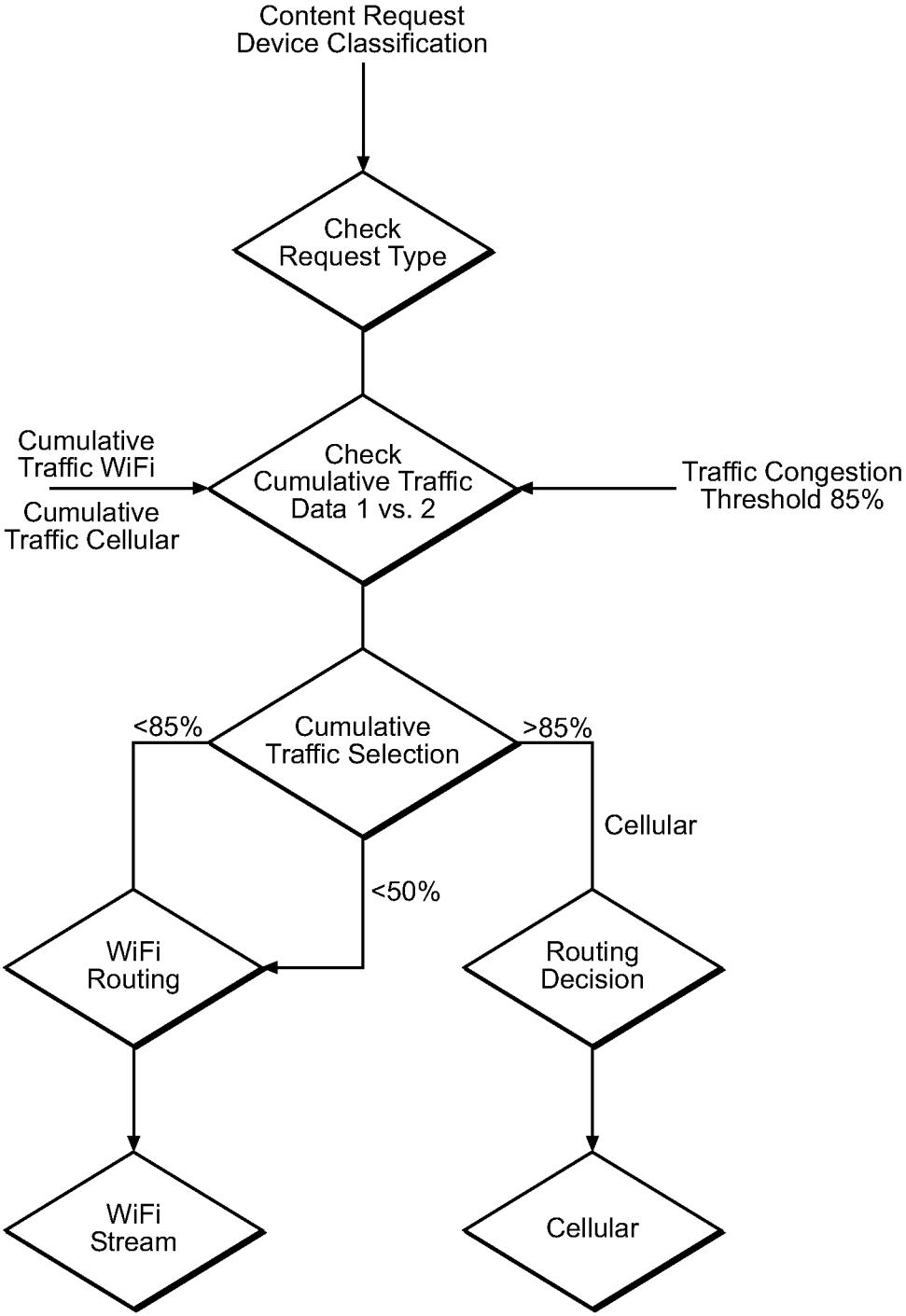

Content Request
Device Classification
Check
Request Type
Cumulative
Traffic WiFi
Cumulative
Traffic Cellular
Check
Cumulative Traffic
Data 1 vs. 2
Traffic Congestion
Threshold 85%
<85%
Cumulative
Traffic Selection
>85%
Cellular
<50%
WiFi
Routing
Routing
Decision
WiFi
Stream
Cellular

FIG. 8A

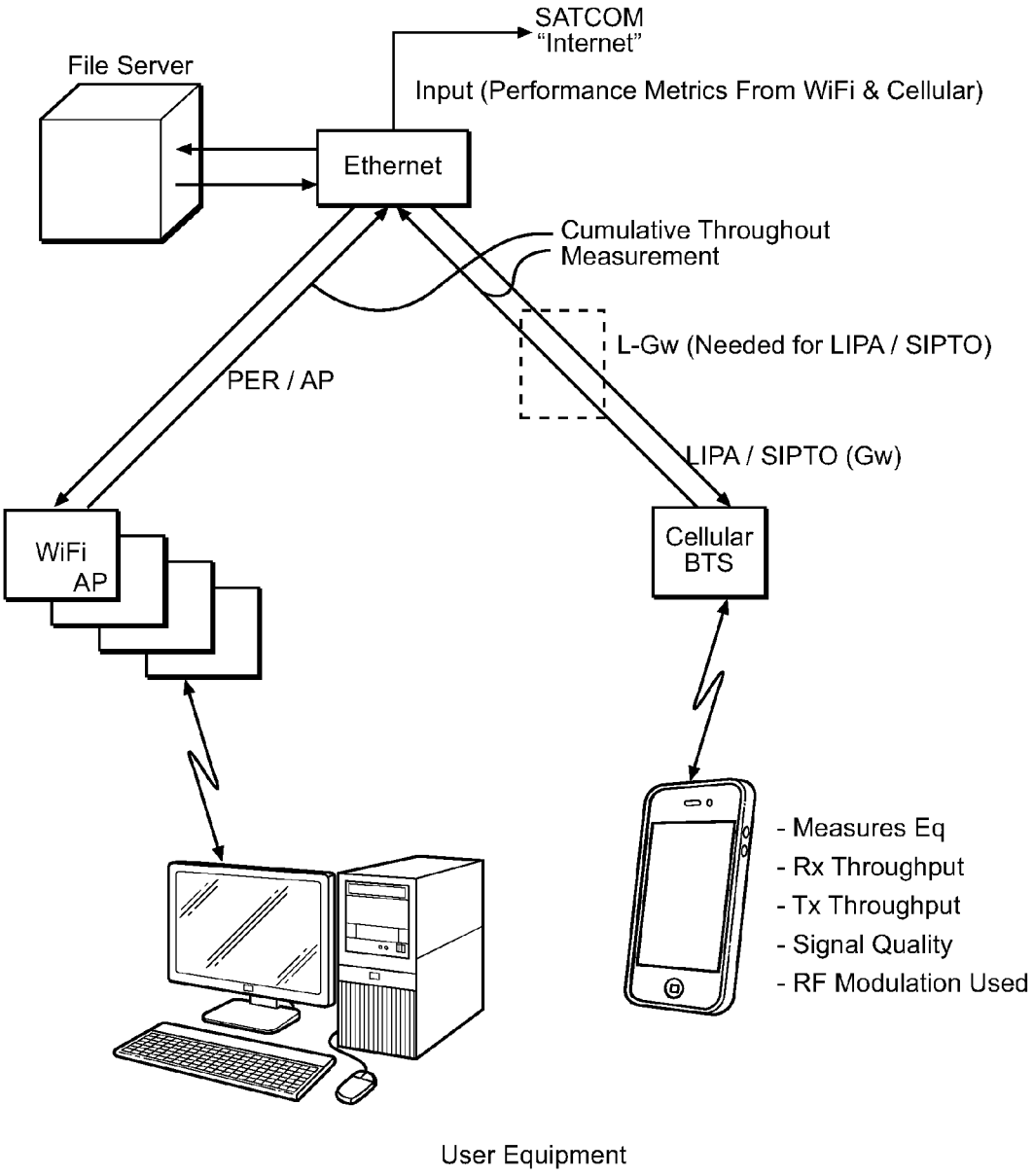

SATCOM
"Internet"
File Server
Input (Performance Metrics From WiFi & Cellular)
Ethernet
Cumulative Throughout
Measurement
L-Gw (Needed for LIPA / SIPTO)
PER / AP
LIPA / SIPTO (Gw)
WiFi
AP
Cellular
BTS
- Measures Eq
- Rx Throughput
- Tx Throughput
- Signal Quality
- RF Modulation Used
User Equipment

FIG. 8B

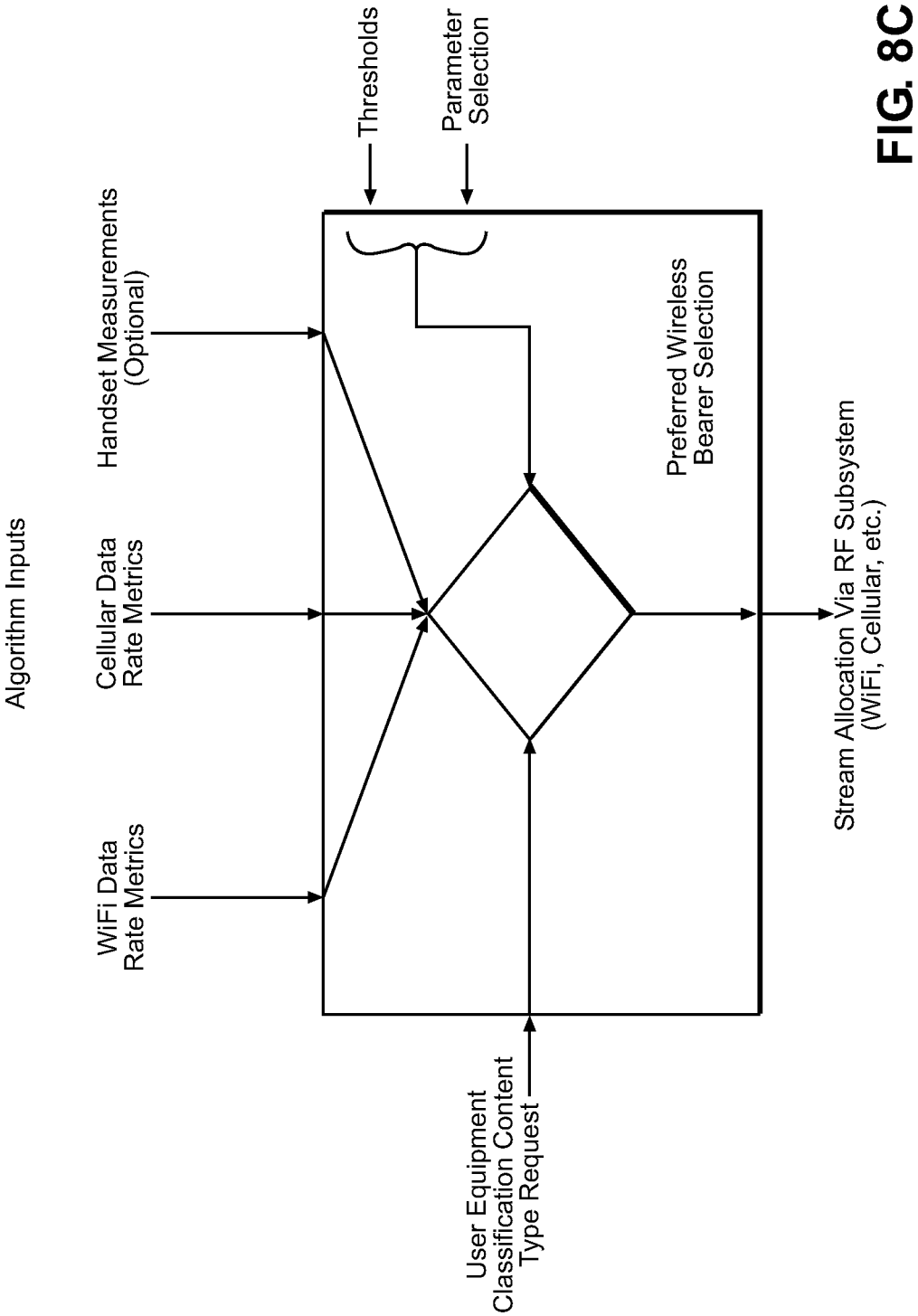

Algorithm Inputs
Handset Measurements (Optional)
Cellular Data Rate Metrics
WiFi Data Rate Metrics
Thresholds
Parameter Selection
Preferred Wireless Bearer Selection
Stream Allocation Via RF Subsystem (WiFi, Cellular, etc.)
User Equipment Classification Content Type Request

FIG. 8C

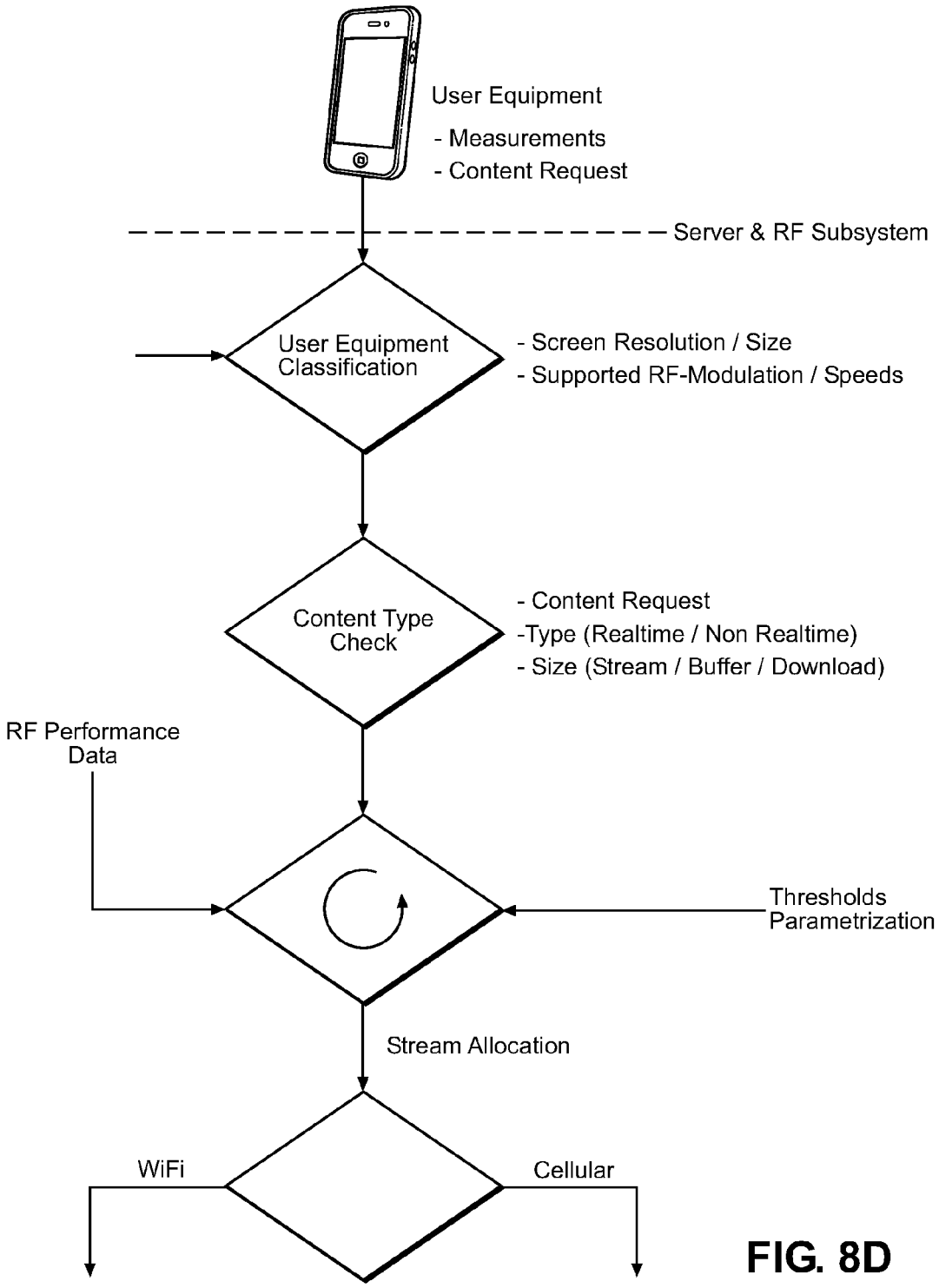

User Equipment
- Measurements
- Content Request
Server & RF Subsystem
User Equipment Classification
- Screen Resolution / Size
- Supported RF-Modulation / Speeds
Content Type Check
- Content Request
-Type (Realtime / Non Realtime)
- Size (Stream / Buffer / Download)
RF Performance Data
Thresholds Parametrization
Stream Allocation
WiFi
Cellular

FIG. 8D

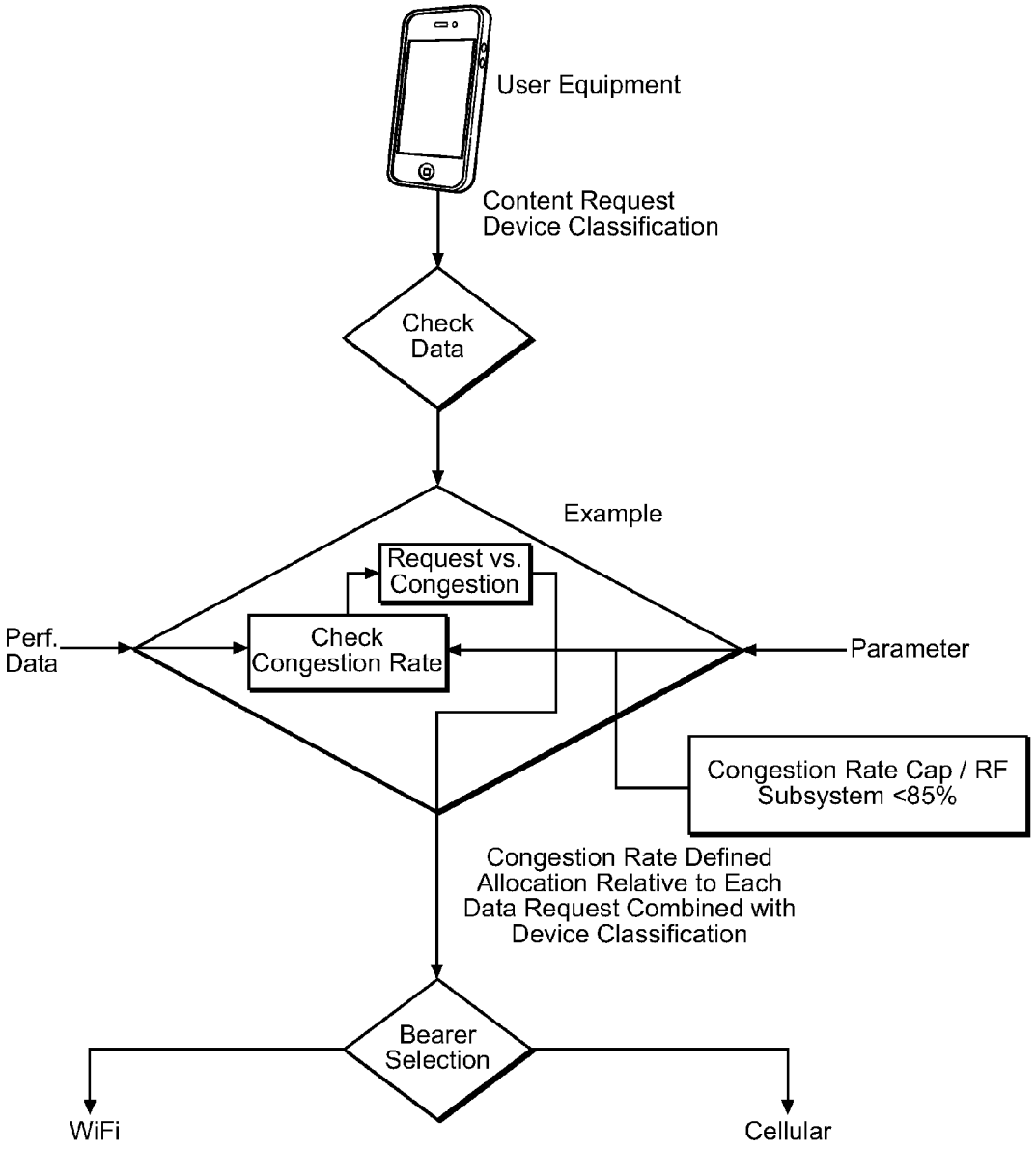

User Equipment
Content Request
Device Classification
Check
Data
Example
Request vs.
Congestion
Perf.
Data
Check
Congestion Rate
Parameter
Congestion Rate Cap / RF
Subsystem <85%
Congestion Rate Defined
Allocation Relative to Each
Data Request Combined with
Device Classification
Bearer
Selection
WiFi
Cellular

FIG. 8E

SYSTEM AND METHOD FOR PROVIDING MULTI-MODE WIRELESS DATA DISTRIBUTION

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority from U.S. Provisional Application No. 61/800,706, filed Mar. 15, 2013. Priority from the foregoing provisional application is expressly claimed and the disclosure thereof is incorporated herein by reference in its entirety and for all purposes.

FIELD

The present disclosure relates generally to content distribution systems and more particularly, but not exclusively, to systems for enabling data distribution over a multi-mode wireless network installed aboard passenger vehicles.

BACKGROUND

Passenger vehicles, such as automobiles and aircraft, often include vehicle information systems for satisfying passenger demand for access to viewing content, such as entertainment, information content, or other viewing content, while traveling.

Conventional vehicle information (or entertainment) systems typically include overhead cabin video systems or seat-based video systems with individual controls such that viewing content is selectable by the passengers. The viewing content can include audio and video content that is derived from a variety of content sources. For instance, prerecorded viewing content, such as motion pictures and music, can be provided by internal content sources, such as audio and video players, that are installed at a headend system of the vehicle. The conventional vehicle information systems likewise can include an antenna system for receiving viewing content, such as live television programming and/or Internet content, transmitted from one or more content providers (or sources) that are external to, and/or remote from, the vehicle.

Furthermore, some vehicle information systems allow passengers to integrate their own personal media devices to facilitate the selection of changing passenger viewing content. These personal media devices are integrated via wired and/or wireless communications. An example of such a passenger information system is described in United States Patent Publication No. 2009/0119721 A1, application Ser. No. 12/210,624, entitled "System and Method for Interfacing a Portable Media Device with a Vehicle Information System," filed on Sep. 15, 2008, which is hereby incorporated by reference in its entirety and fully owned by the assignee of the present application.

Since passenger demand for this viewing content on aircraft video systems and personal media devices is continually evolving, conventional vehicle information systems are experiencing elevated wireless traffic with increased passenger data usage. Communication between the headend system and the personal media devices can include wireless fidelity (Wi-Fi)-based (e.g., Institute of Electrical and Electronics Engineers (IEEE) Standard 802.11) and/or cellular-based wireless networks (e.g., Universal Mobile Telecommunications Systems (UMTS), third-generation (3G) mobile phone systems, fourth-generation (4G) mobile phone systems, and long-term evolution (LTE) standards). Selection of the preferred network for data communication often is based on traffic type. The Wi-Fi network typically is used to access larger data transfers (e.g., streaming both internal and external content sources); while, the cellular-based networks are reserved for roaming cell-type services (e.g., voice calling, texting, and other services). This allocation of network traffic types over the various wireless networks depends on, for example, bandwidth, cellular range, roaming, and other restrictions (e.g., additional fees) set by the cellular service provider.

As an additional drawback, current wireless networks on aircraft effectively operate independently of one another. Selecting a preferred network connection ignores current or expected loads (e.g., coordinated system level load analysis, balancing, and handoff schemes) such that several channels may be left available and unused. Accordingly, some, or all, of the passengers traveling aboard the aircraft can be inhibited from enjoying the viewing content because of the capacity and use of the various wireless networks.

In view of the foregoing, a need exists for an improved content distribution system and method for enabling data distribution over a multi-mode wireless network installed aboard passenger vehicles in an effort to overcome the deficiencies of conventional passenger information systems.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1**A is an exemplary top-level drawing illustrating an embodiment of an information system, wherein a content system communicates with a content transceiver system over a first network and a second network.

FIG. **1**B is an exemplary top-level drawing illustrating an alternative embodiment of the information system of FIG. **1**A, wherein the content system communicates with the content transceiver system over a Wi-Fi network and a cellular network.

FIG. **2**A is a detail drawing illustrating an embodiment of the information system of FIGS. **1**A-B, wherein the information system includes discrete system components installed throughout a passenger vehicle.

FIG. **2**B is a detail drawing illustrating another embodiment of the information system of FIGS. **1**A-B, wherein the information system includes discrete system components installed throughout a passenger vehicle.

FIG. **3**A is a detail drawing illustrating an embodiment of the information system of FIGS. **1**A-B, wherein content is provided to a passenger vehicle according to the system of FIG. **1**.

FIG. **3**B is a detail drawing illustrating another embodiment of the information system of FIGS. **1**A-B, wherein content is provided to a passenger vehicle according to the system of FIG. **1**.

FIG. **4**A is an exemplary top-level drawing illustrating the information system of FIG. **2**, wherein the information system is installed aboard an aircraft.

FIG. **4**B is an exemplary top-level drawing illustration an alternative embodiment of the information system of FIG. **2**, wherein the information system is installed aboard an automobile.

FIG. **5** is an exemplary detail drawing illustrating one embodiment of a distribution system for the information systems of FIGS. **4**A-B.

FIG. **6** is an exemplary detail drawing illustrating an embodiment of a wireless access point for the information system of FIGS. **1**-**5**.

FIG. **7** is an exemplary detail drawing illustrating an alternative embodiment of the information system of FIGS. **4**A-B, wherein the information system includes a telephone system.

FIGS. **8**A-E are exemplary flow charts illustrating various embodiments of a method by which the information system

of FIGS. **1-3** dynamically routes content over the first network and the second network.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Since distribution of viewing content within currently-available passenger information systems is limited by various bandwidth, cellular range, roaming, and content-type restrictions, a coordinated content distribution system that includes a load level analysis for making use of available allocated, pre-allocated, or spare, capacity on various wireless networks can prove desirable and provide a basis for a wide range of system applications, such as vehicle information systems for use aboard automobiles, aircrafts, and other types of passenger vehicles during travel. This result can be achieved, according to one embodiment disclosed herein, by an information system **100** as illustrated in FIGS. **1**A-B.

Turning to FIG. **1**A, the information system **100** is illustrated as including one or more content systems **200** being configured to communicate with one or more content transceiver systems **500**. In order to distribute viewing content **210** between the content systems **200** and the transceiver systems **500**, the information system **100** can exploit the available, or pre-allocated, bandwidth and high-speed connectivity of a first network **300** and/or a second network **400** to maintain a low-cost, high-capacity data connection. The information system **100** thereby can increase the total capacity for content distribution by making use of available allocated, pre-allocated, or spare capacity on the second network **400**—a medium typically reserved for services specific to the second network.

In an embodiment illustrated in FIG. **1**B, the content systems **200** can exchange viewing content **210** with the content transceiver systems **500** in the manner discussed above over the available, or pre-allocated, bandwidth and high-speed connectivity of a wireless fidelity (Wi-Fi) network **300**A and/or a cellular network **400**A to maintain a low-cost, high-capacity data connection. Therefore, the total capacity for content distribution includes the available allocated, pre-allocated, or spare capacity on the cellular network **400**A a medium typically reserved for cellular roaming services.

When both the first network **300** of FIG. **1**A (or Wi-Fi network **300**A of FIG. **1**B) and the second network **400** (or cellular network **400**A of FIG. **1**B) are available, the information system **100** can dynamically route the viewing content **210** across either network (or both networks) to maintain optimum transfer speeds. Accordingly, delays in uploading, downloading, and streaming of viewing content **210** between the content systems **200** and the content transceiver systems **500** is minimized through the simultaneous use of multiple wireless networks.

Although the information system **100** can be disposed in a fixed location, such as a building, the information system **100** likewise advantageously can be applied in portable system applications. For example, turning to FIG. **2**A, the information system **100** is shown as being configured for installation aboard any of a wide variety of passenger vehicles **390** (shown in FIGS. **4**A-B). For illustration purposes only, the content systems **200** communicate with the content transceiver systems **500** (described in FIGS. **1**A-B), such as one or more personal (or portable) user devices **500**A, via a real-time content distribution system **250**.

The content distribution system **250** includes at least one media system controller and file server **240** that can be provided as an information system controller for providing overall system control functions for the information system **100** and/or the content systems **200**. In order to exchange viewing content **210** between the content systems **200** and the user devices **500**A, the content distribution system **250** preferably includes a load analysis/balance and control system **255** for dynamically routing the viewing content **210** over the first network **300** (shown in FIG. **1**A), such as an on-board Wi-Fi network **300**B (in accordance with IEEE Standard 802.11), and/or the second network **400** (shown in FIG. **1**A), such as an on-board cellular network **400**B. The information system **100** thereby can increase the total capacity for content distribution by making use of available allocated, pre-allocated, or spare capacity on the on-board cellular network **400**B.

As illustrated, the on-board cellular network **400**B includes at least one network switching subsystem (NSS) (or cellular core network) interface, such as a Global System for Mobile Communications (GSM) core network interface **410**A, or third-generation (3G)/fourth-generation (4G) core network interfaces (not shown) without limitation, for voice traffic **211**A, and at least one cellular data network interface, such as a packet-oriented data network interface **420**A for digital data **211**B. In one embodiment, the NSS can be provided as a core circuit-switched network for routing voice calls, short message service (SMS), circuit switched data calls, and so on. Exemplary packet-orientated data network interfaces **420**A support 3G mobile phone systems (e.g., Enhanced Data for GSM Evolution (EDGE), Universal Mobile Telecommunications Systems (UMTS), Wideband Code Division Multiple Access (WDMA), CDMA2000, etc.) and 4G mobile phone systems (e.g., Long Term Evolution (LTE), wireless metropolitan-area networks (MANs) (which also are known as WiMax Wireless Broadband, in accordance with IEEE Standard 802.16), etc.) technologies. Additionally, Wi-Fi network **300**B can include a local area network (LAN), a wide area network (WAN), a campus area network (CAN), and/or a personal area network (PAN), of any kind.

The cellular network **400**B additionally includes an operator core network **450** maintained by a roaming cellular service provider. As mentioned above, the personal user devices **500**A communicating with the on-board cellular network **400**B typically depend on services provided (e.g., voice calling, SMS, and so on) through the operator core network **450**. Accordingly, usage of the cellular network **400**B may require payment of a fee to the roaming cellular service provider before access to either of the GSM core network interface **410**A or the packet-oriented data network interface **420**A is permitted. The fee for data transmission over the cellular network **400**B can vary based on, for example, the location of the data transmission and traffic type.

The cellular network **400**B is shown to include an Internet Protocol (IP) bypass system **425**A for providing a cellular transmission path that bypasses the GSM core network interface **410**A and the packet-oriented data network interface **420**A. The load analysis/balance and control system **255** advantageously reroutes network packets (e.g., viewing content **210**)—typically distributed over the Wi-Fi network **300**B—through the cellular network **400**B via the bypass system **425**A (i.e., without being routed through the operator core network **450**). Stated somewhat differently, both of the Wi-Fi network **300**B and the cellular network **400**B can be used to distribute viewing content **210** for maintaining the best overall user experience without incurring additional charges from the roaming cellular service provider.

In one embodiment, the IP bypass system **425**A includes a Local Internet Protocol Access (LIPA) and Selected Internet Protocol Traffic Offload (SIPTO) bypass system, such as a LIPA and SIPTO bypass system **425**B illustrated in FIG. **2**B. Accordingly, the load analysis/balance and control system

255 reroutes network packets (e.g., viewing content 210)—typically distributed over the Wi-Fi network 300B—through the cellular network 400B via the LIPA/SIPTO protocol bypass system 425B (i.e., without being routed through the operator core network 450).

The content systems 200 can include one or more internal content systems, such as one or more on-board media and content (or file) servers 200A, that preferably are installed aboard the vehicle 390, and/or remote (or terrestrial) content systems 200B, that can be external from the vehicle 390. The media and content server 200A can be used for providing local storage of preprogrammed content and/or downloaded viewing content 210D aboard the vehicle 390, as desired. Although not shown, the media system controller and file server 240 can include, and/or communicate with, one or more conventional peripheral media storage systems, including optical media devices, such as a digital video disk (DVD) system or a compact disk (CD) system, and/or magnetic media systems, such as a video cassette recorder (VCR) system or a hard disk drive (HDD) system, of any suitable kind, for storing the preprogrammed content and/or the download viewing content 210D. The media system controller and file server 240 likewise can support decoding and/or digital rights management (DRM) functions of the information system 100.

Each content system 200, for example, can be provided in the manner set forth in the commonly assigned U.S. patents, entitled "SYSTEM AND METHOD FOR DOWNLOADING FILES," U.S. Pat. No. 8,135,773, filed on Feb. 4, 2004; entitled "SYSTEM AND METHOD FOR MANAGING CONTENT ON MOBILE PLATFORMS," U.S. Pat. No. 7,984,190, filed on May 6, 2005; entitled "PORTABLE MEDIA DEVICE AND METHOD FOR PRESENTING VIEWING CONTENT DURING TRAVEL," U.S. Pat. No. 7,945,934, filed on Jun. 15, 2005; entitled "SYSTEM AND METHOD FOR RECEIVING BROADCAST CONTENT ON A MOBILE PLATFORM DURING INTERNATIONAL TRAVEL," U.S. Pat. No. 7,715,783, filed on Nov. 7, 2005; entitled "SYSTEM AND METHOD FOR RECEIVING BROADCAST CONTENT ON A MOBILE PLATFORM DURING TRAVEL," U.S. Pat. No. 8,326,282, filed on Sep. 24, 2008, the respective disclosures of which are hereby incorporated herein by reference in their entireties.

As desired, the content distribution system 250 can include one or more access points, such as a wireless access point (WAP) 310A shown in FIGS. 2A-B, for communicating with the personal user devices 500A over the Wi-Fi network 300B. The WAP 310A is shown as including an access point antenna system 311A. The access point antenna system 311A can transmit and/or receive broadband radio frequency communication signals 210B between the information system 100 and the user devices 500A. Each of the personal user devices 500A includes a device antenna system 501A for communicating with the access point antenna system 311A. The access point antenna system 311A and the device antenna system 501A can comprise any conventional types of antenna systems suitable for transmitting and/or receiving the broadband radio frequency communication signals between the information system 100 and the personal user devices 500A.

Additionally, and/or alternatively, the content distribution system 250 can further include one or more cellular access points, such as an on-board FemtoCell system 430A (e.g., a Home Node B (HNB) or a Home eNode B (HeNB)) shown in FIGS. 2A-B, or an on-board PicoCell system 810 (shown in FIG. 7), for communication with the personal user devices 500A over the cellular network 400B. It should be understood that HNB/HeNB is a 3rd Generation Partnership Project (3GPP) Standard radio access solution. The FemtoCell system 430A is shown as including a cellular antenna system 431A for transmitting and/or receiving cellular communication signals 210A between the information system 100 and the personal user devices 500A. The cellular antenna system 431A can comprise any conventional type of cellular antenna systems, such as one or more leaky feeder systems 850 (shown in FIGS. 5, 7) distributed throughout the vehicle 390, allowing two-way radio communication. Accordingly, the device antenna system 501A and the cellular antenna system 431A can be configured for transmitting and/or receiving the cellular communication signals 210A between the information system 100 and the personal user devices 500A.

Viewing content 210 available via the content system 200 can comprise any conventional type of audio and/or video viewing content, such as stored (or time-delayed) viewing content, live (or real-time) viewing content, and/or interactive viewing content, in the manner set forth in the above-referenced U.S. patents, entitled "SYSTEM AND METHOD FOR DOWNLOADING FILES," U.S. Pat. No. 8,135,773, filed on Feb. 4, 2004; entitled "PORTABLE MEDIA DEVICE AND METHOD FOR PRESENTING VIEWING CONTENT DURING TRAVEL," U.S. Pat. No. 7,945,934, filed on Jun. 15, 2005; and entitled "SYSTEM AND METHOD FOR RECEIVING BROADCAST CONTENT ON A MOBILE PLATFORM DURING INTERNATIONAL TRAVEL," Ser. No. 7,715,783, filed on Nov. 7, 2005. Exemplary viewing content 210 can include media, content, data files, maintenance information, performance information, system usage information, flight planning information (e.g., electronic flight bag information), aircraft operational information (e.g., flight operational quality assurance (FOQA), flight data monitoring (FDM) information, and so on), calling content, text messaging, electronic mail (or e-mail), television programming content, music content, podcast content, photograph album content, audiobook content, movie content, and/or game content without limitation.

As desired, the viewing content 210 can include geographical information in the manner set forth in U.S. Pat. No. 6,661,353, entitled "METHOD FOR DISPLAYING INTERACTIVE FLIGHT MAP INFORMATION," which is assigned to the assignee of the present application and the disclosure of which is hereby incorporated herein by reference in its entirety. The exemplary viewing content as shown and described herein are not exhaustive and are provided herein for purposes of illustration only and not for purposes of limitation.

The viewing content 210 can be presented by the personal user device 500A in any conventional manner, preferably substantially in real-time. For example, the personal user device 500A can download the viewing content in the manner disclosed in the aforementioned co-pending U.S. patent applications, entitled "SYSTEM AND METHOD FOR DOWNLOADING FILES," U.S. Pat. No. 8,135,773, filed on Feb. 4, 2004; entitled "SYSTEM AND METHOD FOR MANAGING CONTENT ON MOBILE PLATFORMS," U.S. Pat. No. 7,984,190, filed on May 6, 2005; entitled "PORTABLE MEDIA DEVICE AND METHOD FOR PRESENTING VIEWING CONTENT DURING TRAVEL," U.S. Pat. No. 7,945,934, filed on Jun. 15, 2005; entitled "SYSTEM AND METHOD FOR RECEIVING BROADCAST CONTENT ON A MOBILE PLATFORM DURING INTERNATIONAL TRAVEL," U.S. Pat. No. 7,715,783, filed on Nov. 7, 2005; entitled "SYSTEM AND METHOD FOR RECEIVING BROADCAST CONTENT ON A MOBILE PLATFORM DURING TRAVEL," U.S. Pat. No. 8,326,282, filed on Sep. 24, 2008, the disclosures of which were incorporated

herein by reference above. As desired, the personal user device **500**A likewise can store the downloaded viewing content. The personal user device **500**A thereby can present the viewing content at any time regardless of whether communication with the content systems **200** is maintained.

The viewing content **210** likewise can be streamed to the personal user device **500**A from the content systems **200**. Stated somewhat differently, the viewing content **210** can be momentarily stored (or cached) by the personal user device **500**A. The viewing content **210** likewise can be streamed in any conventional manner. Illustrative sources for streaming the viewing content **210** can include terrestrial content systems and/or satellite content systems (e.g., terrestrial content system **200**B). For example, live television programming can be streamed by one or more terrestrial content system, such as a broadcast television system (not shown), and/or by one or more satellite content system, such as a Direct Broadcast Satellite (DBS) system (not shown). Exemplary systems and methods for streaming viewing content are shown and described in the co-pending U.S. patent application, entitled "PORTABLE MEDIA DEVICE AND METHOD FOR PRESENTING VIEWING CONTENT DURING TRAVEL," U.S. Pat. No. 7,945,934, filed on Jun. 15, 2005.

Being configured to distribute and/or present the viewing content **210** provided by selected content systems **200**, the information system **100** can communicate with the content systems **200** in real time and in any conventional manner, including via wired and/or wireless communications. For example, the information system **100** and the terrestrial content system **200**B can communicate in any conventional wireless manner, including directly and/or indirectly via an intermediate communication system **370**, such as a satellite communication system **370**A. The information system **100** thereby can receive the download viewing content **210**D from a selected terrestrial content system **200**B and/or transmit upload viewing content **210**U, including navigation and other control instructions, to the terrestrial content system **200**B. As desired, the terrestrial content system **200**B can be configured to communicate with other terrestrial content systems (not shown). The terrestrial content system **200**B is shown in FIGS. **2**A-B as providing access to the Internet **200**C. Although shown and describes as comprising the satellite communication system **370**A for purposes of illustration, it is understood that the communication system **370** can comprise any conventional type of wireless communication system, such as a cellular communication system and/or an Aircraft Ground Information System (AGIS) communication system (not shown).

To facilitate communications with the terrestrial content systems **200**B, the information system **100** can include an aircraft antenna system **330** and an off-aircraft communication controller and modem **340** for exchanging the viewing content with the remote (or terrestrial) content systems **200**B. The antenna system **330** preferably is disposed outside the vehicle **390** and can receive downloaded viewing content **210**D from the terrestrial content system **200**B for providing the received viewing content **210**, as processed by the off-aircraft communication controller and modem **340**, to the media system controller and file server **240**. The off-aircraft communication controller and modem **340** distributes the received viewing content **210** to the personal user devices **500**A through the content distribution system **250** as discussed above. The off-aircraft communication controller and modem **340** is shown being in communication with an aircraft interface system **522**, which provides an interface between the information system **100** and aircraft avionics equipment (not shown) that can be installed aboard a wide-body aircraft.

The illustrated personal user devices **500**A can each store the audio and/or video viewing content **210**. Preferably, the personal user devices **500**A are smartphones capable of cellular- and/or Wi-Fi-based communications; however, it is understood that the personal user devices **500**A can be provided as other handheld devices, such as a laptop computer, a tablet computer, a palmtop computer, a personal digital assistant (PDA), cellular telephone, an iPod® digital electronic media device, an iPhone® digital electronic media device, and/or a MPEG Audio Layer 3 (MP3) device. Other illustrative personal user devices **500**A are shown and described in U.S. Pat. No. 8,135,773, entitled "SYSTEM AND METHOD FOR DOWNLOADING FILES," filed on Feb. 4, 2004; U.S. Pat. No. 7,945,934, entitled "PORTABLE MEDIA DEVICE AND METHOD FOR PRESENTING VIEWING CONTENT DURING TRAVEL," filed on Jun. 15, 2005; U.S. Pat. No. 7,715,783, entitled "SYSTEM AND METHOD FOR RECEIVING BROADCAST CONTENT ON A MOBILE PLATFORM DURING INTERNATIONAL TRAVEL," filed on Nov. 7, 2005; U.S. patent application Ser. No. 12/210,624, entitled "SYSTEM AND METHOD FOR INTERFACING A PORTABLE MEDIA DEVICE WITH A VEHICLE INFORMATION SYSTEM," filed on Sep. 15, 2008; U.S. patent application Ser. No. 12/210,636, entitled "MEDIA DEVICE INTERFACE SYSTEM AND METHOD FOR VEHICLE INFORMATION SYSTEMS," filed Sep. 15, 2008; U.S. patent application Ser. No. 12/210,652, entitled "MEDIA DEVICE INTERFACE SYSTEM AND METHOD FOR VEHICLE INFORMATION SYSTEMS," filed on Sep. 15, 2008; and U.S. patent application Ser. No. 12/210,689, entitled "PORTABLE USER CONTROL DEVICE AND METHOD FOR VEHICLE INFORMATION SYSTEMS," tiled on Sep. 15, 2008, which are all assigned to the assignee of the present application and the respective disclosures of which are hereby incorporated by reference in their entireties.

In order for more than one personal user device **500**A to share access to the wireless networks (e.g., Wi-Fi network **300**B and/or cellular network **400**B), each of the Wi-Fi network **300**B and the cellular network **400**B is configured to authenticate the personal user devices **500**A. Exemplary forms of authentication mechanisms for wireless networks adopt the IEEE 802.1x protocol and may include, for example, Extensible Authentication Protocol (EAP) methods (e.g., Lightweight EAP (LEAP), EAP-Transport Layer Security (EAP-TLS), EAP-MD5, EAP-Protected One-Time Password (EAP-POTP), EAP-Pre-Shared Key (EAP-PSK), EAP-Tunneled Transport Layer Security (EAP-TTLS), EAP-Internet Key Exchange protocol version 2 (EAP-IKEv2), EAP-Flexible Authentication via Secure Tunneling (EAP-FAST), EAP for GSM Subscriber Identity Module (EAP-SIM), EAP Method for UMTS Authentication and Key Agreement (EAP-AKA), EAP-AKA Prime (EAP-AKA'), EAP-Generic Token Card (EAP-GTC), and EAP with the Encrypted key exchange (EAP-EKE)). Once authenticated, the Wi-Fi network **300**B and/or the cellular network **400**B opens a respective secure data channel to the authenticated personal user device **500**A to protect the privacy of data exchanged (e.g., viewing content **210**) with the authenticated device **500**A.

The load analysis/balance and control system **255** can be provided in any conventional manner, such as via one or more hardware components and/or software components, and can be disposed proximately to, and/or remotely from, the content systems **200**. In another embodiment, the load analysis/balance and control system **255** may be installed at each personal user device **500**A (not shown). As illustrated in FIGS. **2**A-B, the exemplary load analysis/balance and control system **255**

monitor incoming traffic loads, such as viewing content **210**, voice traffic **211**A, and/or digital data **211**B. In order to balance the network traffic loads across all available wireless networks (e.g., the Wi-Fi network **300**B and the cellular network **400**B), the load analysis/balance and control system **255** distributes the network traffic based on, for example, current loads, projected loads, number of users, media type, device type, display resolutions, supported radio interfaces, available radio channels, streaming rates, size of media files, passenger viewing and browsing behavior, and so on. For example, the load analysis/balance and control system **255** can include instruction code, such as software or firmware, stored on a computer-readable medium that can be executed by a processor for distributing the network traffic. In one embodiment, the medium can comprise a non-transitory storage medium.

In one example, the load analysis/balance and control system **255** receives mobile metrics from a selected device **500**A. These mobile metrics includes, but are not limited to radio frequency (RF) conditions, signal quality, signal speeds, and device classifications. The load analysis/balance and control system **255** analyses the network traffic for media content type and throughput rate available via the Wi-Fi network **300**B and the cellular network **400**B. Based on a set of predefined conditions (e.g., use of a selected Wi-Fi network **300**B or cellular network **400**B until a congestion point, such as 85-90% of the bandwidth for either the Wi-Fi network **300**B or cellular network **400**B, is reached), the load analysis/balance and control system **255** distributes the network traffic to optimize network bandwidth. These predefined conditions can be modified as desired. Additional examples of methods by which the load analysis/balance and control system **255** distributes network traffic are discussed below with reference to FIGS. **8**A-E.

Although the information system **100** can be used to distribute the viewing content **210** throughout the vehicle **390** to the one or more personal user devices **500**A, as shown in FIGS. **2**A-B, the information system **100** likewise advantageously can be used to load and off-load viewing content **210** between a terrestrial source and at least one of the vehicles **390**. Turning to FIG. **3**A, the information system **100** is shown as being configured for installation at a fixed location, such as an airport terminal. The content systems **200** (shown in FIGS. **1**A-B) include a staging server and storage system **200**D for preparing content **210** provided by the terrestrial content system **200**B. The staging server and storage system **200**D is preferably installed at a location remote from the vehicle **390** (e.g., the airport terminal) and communicates with the transceiver systems **500** (shown in FIGS. **1**A-B), such as vehicles **390**. In order to distribute viewing content **210** provided by the terrestrial content system **200**B to the one or more vehicles **390**, the terrestrial content system **200**B includes the load analysis/balance and control system **255** for dynamically routing the viewing content **210** over the first network **300** (shown in FIG. **1**A), such as a terminal Wi-Fi network **300**C, and/or the second network **400** (shown in FIG. **1**A), such as a terminal cellular network **400**C. However, it should be understood that the load analysis/balance and control system **255** can be installed in any server in communication with the first network **300** and second network **400**. The information system **100** thereby can increase the total capacity for simultaneous content distribution to at least one of the passenger vehicles **390** approaching an airport terminal, taxiing near a gate, or parked at the gate by making use of available allocated or spare capacity on a selected terminal cellular network **400**C to supplement the bandwidth provided by the Wi-Fi network **300**C.

As described in more detail above with reference to FIGS. **2**A-B, the terminal cellular network **400**C includes at least one NSS interface, such as a GSM core network interface **410**B, or 3G/4G core network interfaces (not shown), and at least one cellular data network interface, such as a packet-oriented data network interface **420**B. Services routed through the cellular network **400**C via the operator core network **450** (e.g., cellular data **211**), for example, over a Universal Terrestrial Radio Access Network (UTRAN)/evolved UTRAN (eUTRAN) HNB gateway (HNB-GW) **455**, may incur charges from the roaming cellular service provider. Therefore, the terminal cellular network **400**C includes an IP bypass system **425**C for providing a cellular transmission path that bypasses the GSM core network interface **410**B and the packet-oriented data network interface **420**B. Stated in another way, the IP bypass system **425**C provides a transmission medium that avoids the operator core network **450** and any related service restrictions.

In one embodiment, the IP bypass system **425**C includes a LIPA and SIPTO bypass system, such as a LIPA/SIPTO bypass system **425**D illustrated in FIG. **3**B. Accordingly, the LIPA/SIPTO bypass system **425**D provides a cellular transmission path that bypasses the GSM core network interface **410**B and the packet-oriented data network interface **420**B.

The information system **100** includes one or more terrestrial wireless access points **310**B for communicating with the vehicles **390** over the Wi-Fi network **300**C. Each of the terrestrial WAPs **310**B is shown as including an access point antenna system **311**B for transmitting and/or receiving the broadband radio frequency communication signals **210**B. To facilitate communications with the terrestrial content system **200**B and staging server and storage system **200**D, the aircraft antenna **330** includes a Wi-Fi antenna system **330**A configured for transmitting and/or receiving the broadband radio frequency communication signals **210**B exchanged between the vehicles **390** and the terrestrial content system **200**B (including the staging server and storage system **200**D). The off-aircraft communication controller and modem **340** similarly includes a Wi-Fi terminal wireless LAN unit (TWLU) **340**A, configured as a wireless access bridge for processing the received broadband radio frequency communication signals **210**B (e.g., viewing content **210**) and communicating with the on-board file server **240**.

The aircraft antenna **330** further includes a cellular modem antenna **330**B configured for transmitting and/or receiving cellular communication signals **210**A from the terminal cellular network **400**C. The cellular modem antenna **330**B can comprise any conventional type of cellular antenna systems for allowing two-way radio communication and suitable for installation on the passenger vehicle **390**. The terminal cellular network **400**C includes one or more cellular radio access networks, such as one or more terminal FemtoCell systems **430**B and/or a PicoCell system (not shown) installed at an airport terminal, for communicating with the passenger vehicles **390**. A terminal radio data link system **431**B of the cellular access points **430**B is configured to transmit and/or receive the cellular communication signals **210**A exchanged between the passenger vehicles **390** and the terrestrial content system **200**B (including the staging server and storage system **200**D).

When the passenger vehicle **390** and the terrestrial content systems **200**B, **200**D are in communication, the load analysis/balance and control system **255** determines an appropriate distribution of network traffic (i.e., ground-based viewing content **210**) over the terminal Wi-Fi network **300**C and/or the terminal cellular network **400**C. For example, this network traffic can include media load updates, media content, main-

tenance data, performance information, system usage, flight planning information (e.g., electronic flight bag data), operational information (e.g., FOQA, FDM, and so on), security updates, software content, and so on for loading onto and off-loading from the passenger vehicle **390**. As described with reference to FIGS. **2**A-B, the load analysis/balance and control system **255** distributes the network traffic based on, for example, current loads, projected loads, number of users, media type, device type, display resolutions, supported radio interfaces, available radio channels, streaming rates, size of media files, passenger viewing and browsing behavior, and so on. Furthermore, the load analysis/balance and control system **255** receives performance input (e.g., network interference measurements) from the terrestrial WAPs **310**B to distribute the network traffic. In order to balance the network traffic loads across all available wireless networks, the network capacities of the Wi-Fi network **300**C and the terminal cellular network **400**C (i.e., via IP bypass system **425**C and/or LIPA/SIPTO bypass system **425**D) are considered. Accordingly, the information system **100** advantageously reroutes network packets (e.g., viewing content **210**)—typically distributed over the Wi-Fi network **300**C—through the cellular network **400**C via IP bypass system **425**C and/or LIPA/SIPTO bypass system **425**D (i.e., without being routed through the operator core network **450**).

As illustrated, each of the passenger vehicles **390** simultaneously can exchange viewing content **210** over any of the available terminal FemtoCell systems **430**B. For example, the information system **100** can service both an aircraft **390**C and an aircraft **390**D by supplementing the Wi-Fi data link (e.g., via Wi-Fi network **300**C) (a wireless connection between the aircraft and the gate commonly known as a gatelink) with a cellular data link (e.g., via cellular network **400**C). Supplementing the conventional gatelink provides for a transmission of large files (e.g., viewing content **210**) without incurring high service provider or roaming fees while reducing the load on the mobile operator core network **450**. Furthermore, it is understood that cellular data links can be used at a greater range when the passenger vehicles **390** are in motion. Thereby, the cellular data link advantageously increases not only network bandwidth at the airport terminal, but also connection range when the aircraft is parked, taxiing, and/or approaching the terminal.

It is noted that the load analysis/balance and control system **255** is configured for distribution of viewing content **210** both throughout the vehicle **390** (as described with reference to FIGS. **2**A-B) and between a terrestrial source and at least one of the vehicles **390** (as described with reference to FIGS. **3**A-B) in one embodiment. Those with ordinary skill in the art can make modifications to the load analysis/balance and control system **255** within the scope of the present embodiments.

In the manner discussed above with reference again to FIGS. **2**A-B, the information system **100** can be configured for installation aboard a wide variety of passenger vehicles **390**. Turning to FIGS. **4**A-B, exemplary types of vehicles can include an aircraft **390**A (shown in FIG. **4**A), an automobile **390**B (shown in FIG. **4**B), a bus, a recreational vehicle, a boat, and/or a locomotive, or any other type of passenger vehicle without limitation. If installed on an aircraft **390**A, as illustrated in FIG. **4**A, for example, the information system **100** can comprise a conventional aircraft passenger in-flight entertainment system, such as the Series 2000, 3000, eFX, and/or eX2 in-flight entertainment system as manufactured by Panasonic Avionics Corporation (formerly known as Matsushita Avionics Systems Corporation) of Lake Forest, Calif.

The antenna system **330** preferably is disposed outside the vehicle **390**, such as an exterior surface **394** of a fuselage **392** of the aircraft **390**B. Although shown and described as being separate systems for purposes of illustration, the off-aircraft communication controller and modem **340** and the media server system **240** can be at least partially integrated. Similarly, the transceiver system **340** may comprise separate components, such as a modem and a communication controller for receiving the viewing content from the remote (or terrestrial) content systems **200**B. The off-aircraft communication controller and modem **340** distributes the viewing content **210** to the personal user devices **500**A through the content distribution system **250** in the manner discussed above with reference to FIGS. **2**A-B. In one embodiment, this distribution may occur during flight, approaching an airport terminal, taxiing near a gate, or parked at the terminal.

The information system **100** components, including the content systems **200** and the personal user devices **500**A, are shown in FIGS. **4**A-B as communicating via the content distribution system **250**. FIG. **5** illustrates an exemplary content distribution system **250** for the information system **100**. The content distribution system **250** of FIG. **5** couples, and supports communication between a headend system **310**H, which includes the content systems **200**, and the personal user devices **500**A. In one embodiment, the distribution system **250** as shown in FIG. **5** can be provided in the manner set forth in U.S. Pat. No. 7,675,849, entitled "SYSTEM AND METHOD FOR ROUTING COMMUNICATION SIGNALS VIA A DATA DISTRIBUTION NETWORK," and in U.S. Pat. Nos. 5,596,647, 5,617,331, and 5,953,429, each entitled "INTEGRATED VIDEO AND AUDIO SIGNAL DISTRIBUTION SYSTEM AND METHOD FOR USE ON COMMERCIAL AIRCRAFT AND OTHER VEHICLES," which are assigned to the assignee of the present application and the respective disclosures of which are hereby incorporated herein by reference in their entireties. Alternatively, and/or additionally, the distribution system **250** can be provided in the manner set forth in the co-pending U.S. patent application "OPTICAL COMMUNICATION SYSTEM AND METHOD FOR DISTRIBUTING CONTENT ABOARD A MOBILE PLATFORM DURING TRAVEL," Ser. No. 12/367,406, filed Feb. 6, 2009, which is assigned to the assignee of the present application and the disclosure of which is hereby incorporated herein by reference in its entirety.

As desired, the distribution system **250** likewise can include a network management system (not shown) provided in the manner set forth in co-pending U.S. patent applications, entitled "SYSTEM AND METHOD FOR IMPROVING NETWORK RELIABILITY," Ser. No. 10/773,523, filed on Feb. 6, 2004, and entitled "SYSTEM AND METHOD FOR IMPROVING NETWORK RELIABILITY," Ser. No. 11/086,510, filed on Mar. 21, 2005, which are assigned to the assignee of the present application and the respective disclosures of which are hereby incorporated herein by reference in their entireties.

As illustrated in FIG. **5**, the distribution system **250** can be provided as a plurality of line replaceable units (LRUs), including area distribution boxes (ADBs) **322**, a plurality of WAPs **310**A, and the FemtoCell systems **430**A being configured to communicate in real time via a plurality of wired and/or wireless communication connections. The line replaceable units of the distribution system **250** likewise can include a switching system **321** for providing an interface between the distribution system **250** and the headend system **310**H. The switching system **321** can comprise a conventional switching system, such as an Ethernet switching system, and is configured to couple the headend system **310**H with the area distribution boxes **322** and the cellular access points

(e.g., FemtoCell systems **430**A). Each of the area distribution boxes **322** and the cellular access points (e.g., FemtoCell systems **430**A) are coupled with, and communicates with, the switching system **321**. The leaky feeder systems **850**, similar to the cellular antenna system **431**A (shown in FIGS. **2**A-B), are configured for exchanging cellular communication signals with the personal user devices **500**A.

Each of the area distribution boxes **322**, is also coupled with, and communicates with, at least one WAP **310**A. Although the area distribution boxes **322** and the associated WAPs **310**A can be coupled in any conventional configuration, the associated WAPs **310**A preferably are disposed in a star network topology about a central area distribution box **322** as illustrated in FIG. **5**. Each WAP **310**A communicates with and services, a plurality of personal user devices **500**A. Alternatively, the area distribution boxes **322** can be coupled with, and communicate with at least one floor disconnect box (not shown) that, in turn, communicates with at least one seat electronic box for supporting both wired and/or wireless communications in the manner set forth in co-pending U.S. patent application, entitled "SYSTEM AND METHOD FOR RECEIVING BROADCAST CONTENT ON A MOBILE PLATFORM DURING TRAVEL," Ser. No. 12/237,253, filed on Sep. 24, 2008, which is fully owned by the assignee of the present application and is hereby incorporated by reference in its entirety for all purposes.

An exemplary wireless access point **310**A for the information system **100** (shown in FIGS. **2**, **4**A-B, **5**) is illustrated in FIG. **6**. The wireless access point **310**A is shown as including an input/output (I/O) processor system **610** that communicates with an Ethernet transceiver **620**. The wireless access point **310**A has a communication port **630** for exchanging Ethernet signals (not shown) with a broadband control system **514** (shown in FIG. **7**) and/or a selected ADB **322** (shown in FIG. **5**) of the information system **100**. The input/output (I/O) processor system **610** likewise can communicate with a wireless module system **660**. The wireless module system **660** is coupled with the access point antenna system **311**A (likewise, can be coupled with the access point antenna system **311**B of FIGS. **3**A-B) and enables the access point antenna system **311**A to transmit and/or receive broadband radio frequency communication signals (e.g., viewing content **210**B shown in FIGS. **2**A-B) between the information system **100** and the personal user devices **500**A (shown in FIGS. **2**, **4**A-B, **5**). As shown in FIG. **6**, the wireless access point **310**A includes a power supply system **640** that receives incoming power from the ADB **322** and that provides operating power for the wireless access point **310**A.

In operation, the information system **100** advantageously can support bidirectional data transfers at significant data rates. For example, the information system **100** can support (forward link) data downloads with data rates of up to approximately 10 Mbps-15 Mbps or higher and (return link) data uploads with data rates of up to approximately 1.5 Mbps or higher. The bandwidth used by a typical passenger (or user) during eight hours of travel can be about 7 Mbps. As set forth above, the information system **100** can permit access to the Internet **200**C in any conventional manner, including via the personal media device **500**A (shown in FIGS. **2**, **4**-**5**) that communicates with the information system **100** via a wired and/or wireless access points **310**A (shown in FIGS. **2**A-B) and/or the cellular access points (e.g., FemtoCell systems **430**A) of the information system **100**. As desired, the personal user device **500**A can comprise a stand-alone installation such that the personal user device **500**A operates as an independent passenger data network via the access points **310**A and/or the cellular access points/radio access networks (e.g., FemtoCell systems **430**A, base transceiver stations (BTS), HNBs, and HeNBs). Connectivity preferably is accomplished via the personal user device **500**A.

When installed aboard an aircraft **390**A, for example, the information system **100** preferably presents a broadband portal application that provides users (or passengers) with onboard access to a premier set of in-flight Intranet and Internet, information, entertainment, communications, and/or other system services during travel. Selected system services may be provided at no cost to the user (or passenger); whereas, other selected system services may require payment of a fee before access to the system services is permitted. The system services can include access to websites on the World Wide Web via the onboard intranet. Thereby, the user can have direct access to virtually any site on the Internet **200**C. Access to selected sites, such as web sites that present obscene or otherwise objectionable material, may be limited during travel. Stated somewhat differently the information system **100** can provide website filtering/blocking of objectionable content, unauthorized site and services which require excess bandwidth. The user likewise can send and/or receive electronic mail (or email) message by directly accessing their business and/or personal email accounts. As desired, an authorized user can establish a connection to a virtual private network (VPN). The user can access instant messaging (IM) and/or Short Message Service (SMS).

As previously discussed, the user can access viewing content **210** stored by the information system **100**. The stored viewing content **210** can include premium viewing content **210**, such as selected television programming, movies, and/or short films. Electronic magazines (e-zines), newspapers and other publications likewise can be provided as the viewing content **210**. The information system **100** preferably provides a standard selection of publications and/or publications that are specifically selected to appeal to user demographics. As desired, the viewing content **210** can be selected and/or manipulated to increase font size and reviewed while on the aircraft **390**A. Electronic publications may be removed from the aircraft **390**A if purchased.

Additionally, and/or alternatively, the user can access onboard games and/or view advertising, news, weather, sports financial, and/or other types of viewing content **210**. The viewing content **210** can be selected, for example, based upon the user's interests and/or the region of travel. The advertising content can include Web advertising content. The user likewise can access airline information content, which can includes maps, connecting gate information, arrival/departure information, and/or destination information based on airline preference. The information system **100** can offer viewing content **210** provided via one or more channels of Internet Protocol Television (IPTV) programming and/or Internet Protocol (IP) Radio programming. The IPTV programming can include live programming that is focused on news and sports. Other types of IPTV programming may be delivered over the broadband link but not in a real-time fashion and usually during non-peak network demand periods.

As set forth above, selected system services of the information system **100** may require payment of a fee before access to the system services is permitted. Exemplary fee-based system services can include pay-per-use services and/or in-flight shopping. The pay-per-use services can include specialty system services, such as streaming audio, streaming video, IPTV programming, and system services that utilize the broadband telecommunications link with the terrestrial content system **200**B. Exemplary system services that utilize the broadband telecommunications link include instant messaging (IM), Short Message Service (SMS), restaurant reser-

vations, tee times, online bookings, and and/or access to games. The fee for these system services can vary based on the particular feature accessed. The information system **100** likewise can provide computer games and/or multi-player games, which can be charged on an unlimited play of a title basis and/or unlimited play of games from the same distributor.

In-flight shopping advantageously permits a user (or Web shopper) to make purchases by browsing a selected Web site, selecting an item registering on the site, providing a credit card number and shipping information. The sales information can be transmitted to the Web vendor who, upon verifying the credit card information, ships the purchased item. The preferably receives a confirmation number. As desired, the graphic content of e-commerce web sites can be re-hosted and stored on the server system **240** (shown in FIGS. **2**A-B). Airborne viewing content **210** can be synchronized with the ground-based viewing content **210** and provide regular updates for pricing, product, etc., in the manner set forth with reference to FIGS. **3**A-B and/or any other conventional loading/off-loading method. Preferably, the information system **100** can select appropriate e-commerce partners to match user demographics and preferences regarding markets and services.

If he elects to make a purchase while browsing the selected. Web site, the users can provide purchase authorization information, such as credit card verification information, to confirm that the user is authorized to make the purchase. As desired, the information system **100** can include a card reader (not shown) for reading purchase authorization information provided by various types of cards, such as credit cards, frequent flyer cards, and the like. The information system **100** can authenticate the purchase authorization information in real time to avoid transaction processing delays and potential fraud. As needed, the information system **100** can cache the purchase authorization information while the satellite link is not available. The purchase authorization information thereby can be transmitted once the satellite link becomes available in the manner discussed with reference to FIGS. **3**A-B. The information system **100** preferably provides purchase confirmation information, such as a confirmation number, upon verifying the purchase authorization information.

Returning to FIGS. **4**A-B, the personal user devices **500**A are provided for selecting viewing content **210** and for presenting the selected viewing content **210**. When the personal user devices **500**A and the information system **100** are in communication, the information system **100** can perform a plurality of integration tasks simultaneously, enabling the personal user device **500**A to become fully integrated with the information system **100** via a selected access point **310**A or a selected cellular access point/radio access network (e.g., FemtoCell system **430**A, BTS, HNB, and HeNB). The system components of the information system **100** and the personal user device **500**A thereby become interchangeable. The personal user device **500**A likewise can receive control signals (or commands) **220** and/or operating power from the information system **100**. For example, user instructions **230** for controlling the operation of the information system **100** can be provided via the personal user device **500**A. In other words, the personal user device **500**A can be used to select viewing content **210** and control the manner in which the selected viewing content **210** is received and/or presented. Thereby, the personal user device **500**A advantageously can become a seamless part of the information system **100**. As desired, the personal user devices **500**A can comprise conventional passenger interfaces and can be provided in the manner set forth in the above-referenced U.S. Pat. No. 7,945,934, entitled "PORTABLE MEDIA DEVICE AND METHOD FOR PRESENTING VIEWING CONTENT DURING TRAVEL," as well as in the manner set forth in the co-pending U.S. patent application, entitled "SYSTEM AND METHOD FOR PRESENTING HIGH-QUALITY VIDEO TO PASSENGERS ON A MOBILE PLATFORM," Ser. No. 60/673,171, filed on Apr. 19, 2005, the disclosure of which is hereby incorporated herein by reference in its entirety.

When used on-board a passenger vehicle, another selected embodiment of the information system **100** is shown and described with reference to FIG. **7**. Turning to FIG. **7**, the information system **100** is shown as including a telephone system **800**. Like the cellular access points (shown in FIGS. **2**, **4**A-B), the telephone system **800** can be provided as a FemtoCell telephone system **420**A (shown in FIGS. **2**A-B), a PicoCell telephone system **810** and/or can support mobile telephone connectivity within the passenger vehicle **390** (shown in FIGS. **4**A-B). The information system **100** thereby enables users (or passengers) to operate their personal user devices **500**A that support cellular communication connections while traveling aboard the passenger vehicle **390**. By integrating the telephone system **800** for on-board systems, the information system **100** advantageously can not only provide robust cellular telephone service that has greater simultaneous calling capacity and that has lower per minute cost than conventional cellular telephone systems, but also increase the total capacity for content distribution by making use the available allocated or spare capacity over of both the telephone system **800** and that provided by WAPs **310**A.

As shown in FIG. **7**, the PicoCell system **810** communicates with one or more radio frequency (RF) management systems **820** and/or aerial combiner unit (ACU) systems **830**. The PicoCell system **810**, the radio frequency (RF) management systems **820**, and the aerial combiner unit systems **830** are shown as communicating via coaxial communication connections **840**. Each aerial combiner unit system **830** provides the at least one leaky feeder system **850** in the manner discussed with reference to FIG. **5**. The PicoCell system **810** and/or at least one of the radio frequency management systems **820** can communicate with the aircraft interface system **522** via a high-speed 10/100/1000 Base-SX/T Ethernet communication connection **860**.

The telephone system **800** preferably receives the cellular communication signals and converts the cellular communication signals into a Voice-over-Internet-Protocol (VoIP) format for transmission to the content system **200** (shown in FIG. **1**A) via a broadband communication system **510** and the satellite communication system **370**A (shown in FIGS. **2**A-B). Incoming VoIP signals can be converted by the telephone system **800** into cellular communication signals that are transmitted to the personal user devices **500**A. The information system **100** thereby can maximize content distribution channels by exploiting a predetermined number of cellular telephone channels for cabin internal seat-to-seat communication and/or for air-to-ground communication.

The broadband communication system **510** is illustrated as including a broadband antenna system **512** and the broadband control system **514**. Preferably being disposed under, and protected by, a radome, the broadband antenna system **512** can be provided in the manner set forth above with reference to the antenna system **330** (shown in FIGS. **2**-**4**) and operates under control of the broadband control system **514**. Exemplary antenna systems and control systems are shown and described in set forth in the above-referenced co-pending U.S. patent application, entitled "SYSTEM AND METHOD FOR RECEIVING BROADCAST CONTENT ON A MOBILE PLATFORM DURING INTERNATIONAL

TRAVEL," Ser. No. 11/269,378, filed on Nov. 7, 2005. An exemplary broadband antenna system is the MiJet broadband antenna system formerly manufactured by Starling Advanced Communications Ltd., of Yoqneam, Israel in which Starling has since been acquired by Panasonic Avionics Corporation of Lake Forest, Calif., USA and now manufactures the foregoing broadband antenna system. The information system **100** thereby can support a broadband network load of approximately 18 Mbits/s for downstream traffic and 4.2 Mbits/s for upstream traffic.

The broadband control system **514** can include a conventional satellite modem system (not shown) and/or a media server system that is provided in the manner set forth above with reference to the media server system **240** (shown in FIGS. **2**A-B).

As previously discussed, the load analysis/balance and control system **255** distributes the network traffic based on, for example, current loads, projected loads, number of users, media type, device type, display resolutions, supported radio interfaces, available radio channels, streaming rates, size of media files, passenger viewing and browsing behavior, and so on. Turning to FIGS. **8**A-E, various distribution methods are illustrated. For example, with reference to FIG. **8**A, the load analysis/balance and control system **255** receives a content request device classification. After checking the request type, the load analysis/balance and control system **255** checks the cumulative network traffic over both the first network **300** (e.g., Wi-Fi network **300**B shown in FIG. **2**A) and the second network **400** (e.g., cellular network **400**B as shown in FIG. **2**A). In this example, a predefined congestion rate of 85% occupancy is used. Stated in another way, the load analysis/balance and control system **255** selects the Wi-Fi network **300**B for distribution if the cellular network **400**B is using 85% of its available bandwidth. Similarly, the cellular network **400**B is selected if the Wi-Fi network **300**B is using 85% of its bandwidth.

In another example illustrated in FIG. **8**B, the load analysis/balance and control system **255** measures both performance metrics of the wireless networks (e.g., Wi-Fi network **300**B and cellular network **400**B) and performance metrics (e.g., transmission/reception throughput, signal quality, RF modulation, and so on) of the content transceiver system **500** to select the optimal wireless network. FIG. **8**C illustrates measuring performance metrics of both the networks **300** and **400** and the content transceiver system **500** in addition to selecting the network based on predefined conditions (e.g., thresholds and parameter selections).

In yet another example illustrated in FIGS. **8**D-E, specific parameters are considered including, but not limited to, RF performance, classification of the content transceiver system **500**, content type (e.g., real-time, non real-time, and so on), content size (e.g., stream, buffer, download), and congestion rate.

The described embodiments are susceptible to various modifications and alternative forms, and specific examples thereof have been shown by way of example in the drawings and are herein described in detail. It should be understood, however, that the described embodiments are not to be limited to the particular forms or methods disclosed, but to the contrary, the present disclosure is to cover all modifications, equivalents, and alternatives.

What is claimed is:

1. A system for distributing content among a plurality of handheld devices, comprising:

a first communication connection in communication with a first wireless network for distributing the content;

a second communication connection in communication with a second wireless network that includes an operator core network; and

an IP broadband bypass system being in communication with the first and the second communication connection for simultaneously distributing selected content to the plurality of handheld devices using both of the first and second wireless networks, except if at least one of the first and second wireless network is using at least eight-five percent of its available bandwidth, then:

if the first wireless network is using at least eight-five percent of its available bandwidth, the second wireless network is selected to distribute the selected content, and

if the second wireless network is using at least eight-five percent of its available bandwidth, the first wireless network is selected to distribute the selected content,

wherein said IP broadband bypass system distributes the selected content over the second wireless network without the selected content being routed through the operator core network.

2. The system of claim **1**, wherein the IP broadband bypass system includes a Local Internet Protocol Access (LIPA) and Selected Internet Protocol Traffic Offload (SIPTO) bypass system.

3. The system of claim **1**, wherein the first wireless network is a wireless fidelity (Wi-Fi) network, and wherein the second wireless network is a cellular network.

4. The system of claim **3**, wherein the cellular network is selected from a group consisting of a Global System for Mobile Communications (GSM) network, a third-generation (3G) mobile phone network, and a fourth-generation (4G) mobile phone network.

5. The system of claim **3**, wherein said second communication connection includes at least one of a PicoCell system and a FemtoCell system.

6. The system of claim **1**, wherein the selected content is selected from a viewing content group consisting of content associated with in-transit shopping, the Internet, entertainment media, electronic mail, corporate virtual private networks, customer virtual private networks, streamed media, and an Intranet system.

7. The system of claim **1**, further comprising a local content system, wherein the plurality of handheld devices can select and present content available from the local content system.

8. The system of claim **1**, further comprising a remote content system, wherein content available from the remote content system can be distributed throughout the plurality of handheld devices via a satellite communication system.

9. The system of claim **8**, wherein the plurality of handheld devices are configured to receive the content streamed from the remote content system.

10. The system of claim **1**, wherein each of the first communication connection and the second communication connection are configured for authenticating the plurality of handheld devices.

11. The system of claim **10**, wherein the first communication connection and the second communication connection are configured for authenticating based on Extensible Authentication Protocol (EAP) methods.

12. The system of claim **1**, wherein said IP broadband bypass system selects at least one of the first and second wireless network for distributing the selected content to the plurality of handheld devices based on loading factors selected from the group consisting of current loads, projected loads, number of users, media type, type of the handheld devices, display resolutions, supported radio interfaces,

available radio channels, streaming rates, size of media files, passenger viewing behavior, and passenger browsing behavior.

13. The system of claim **1**, wherein the system is configured for installation aboard a passenger vehicle.

14. The system of claim **13**, wherein the passenger vehicle comprises an aircraft.

15. A method for distributing content among a plurality of passenger vehicles, comprising:

establishing a first communication connection with a first wireless network;

establishing a second communication connection with a second wireless network that includes an operator core network;

simultaneously distributing selected content to the plurality of passenger vehicles over both of the first and second wireless networks via an IP bypass system, except if at least one of the first and second wireless network is using at least eight-five percent of its available bandwidth, then:

if the first wireless network is using at least eight-five percent of its available bandwidth, simultaneously distributing the selected content over the second wireless network, and

if the second wireless network is using at least eight-five percent of its available bandwidth, simultaneously distributing the selected content over the first wireless network,

wherein said distribution over the second wireless network bypasses the operator core network.

16. The method of claim **15**, wherein the first wireless network is a wireless fidelity (Wi-Fi) network, and wherein the second wireless network is a cellular network.

17. The method of claim **15**, wherein said simultaneously distributing comprises optimizing a total network bandwidth of both of the first and second wireless networks based on one or more loading factors.

18. The method of claim **17**, wherein said one or more loading factors is selected from a group consisting of current loads, projected loads, number of users, media type, size of media files, passenger viewing behavior, and passenger browsing behavior.

19. The method of claim **15**, wherein the selected content is selected from a viewing content group consisting of content associated with media, content, data files, maintenance information, performance information, system usage information, flight planning information, flight operational quality assurance (FOQA), flight data monitoring (FDM) information, calling content, text messaging, electronic mail (e-mail), television programming content, music content, podcast content, photograph album content, audiobook content, movie content, and game content.

20. A system for distributing content among a plurality of passenger vehicles, comprising:

a first communication connection in communication with a first wireless network for distributing the content;

a second communication connection in communication with a second wireless network that includes an operator core network; and

an IP broadband bypass system being in communication with the first and the second communication connection for simultaneously distributing selected content to the plurality of passenger vehicles using both of the first and second wireless networks, except if at least one of the first and second wireless network is using at least eight-five percent of its available bandwidth, then:

if the first wireless network is using at least eight-five percent of its available bandwidth, the second wireless network is selected to distribute the selected content, and

if the second wireless network is using at least eight-five percent of its available bandwidth, the first wireless network is selected to distribute the selected content,

wherein said IP broadband bypass system distributes the selected content over the second wireless network without the selected content being routed through the operator core network.

21. The system of claim **20**, wherein the first wireless network is a wireless fidelity (Wi-Fi) network, and wherein the second wireless network is a cellular network.

22. The system of claim **20**, wherein said IP broadband bypass system includes a LIPA and SIPTO bypass system.

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